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AJO PEAK TO TINAJAS ALTAS: A FLORA OF SOUTHWESTERN ARIZONA PART 15. EUDICOTS: FAGACEAE TO LYTHRACEAE

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ABSTRACT

A floristic and natural history account is provided for 11 eudicot families as part of the vascular plant flora of the contiguous protected areas of Organ Pipe Cactus National Monument, Cabeza Prieta National Wildlife Refuge, and the Tinajas Altas Region in the heart of the Sonoran Desert in southwestern Arizona: Fagaceae, Fouquieriaceae, Gentianaceae, Geraniaceae, Grossulariaceae, Koeberliniaceae, Krameriaceae, Lamiaceae, Linaceae, Loasaceae, and Lythraceae.

This is the fifteenth installment of our flora in southwestern Arizona and includes 11 eudicot families: Fagaceae (1 species), Fouquieriaceae (1 species); Grossulariaceae (1 species); Koeberliniaceae (1 species); Linaceae (1 species); Lythraceae (1 species); Krameriaceae (1 genus, 2 species); Gentianaceae (2 genera, 2 species); Geraniaceae (2 genera, 3 species); Loasaceae (3 genera, 9 species), and Lamiaceae (8 genera, 13 species) (Table 1). The flora area covers 5141 km^2 (1985 mi^2) of contiguous protected areas in the heart of the Sonoran Desert (Figure 1). This publication is also available open access on the website of the University of Arizona Herbarium (https://ag.arizona.edu/herbarium).

The first article in this series includes maps and brief descriptions of the physical, biological, ecological, floristic, and deep history of the flora area (Felger et al. 2013a). This flora includes the modern, present-day taxa as well as fossil records from packrat middens. Explanation of the format for the flora series is provided in part 3 (Felger et al. 2013b). Family designations follow APG III (Angiosperm Phylogeny Group 2009) and the Angiosperm Phylogeny Website (Stevens 2012). *Erodium cicutarium* and *Linum bienne*, non-native taxa established in the flora area, are marked with an asterisk (*) and two non-natives not established in the flora area, *Salvia reflexa* and *Punica granatum*, are marked with double asterisks (**). Fossil specimens are indicated with a dagger symbol (†) and fossil specimens of the one species no longer present in the flora area (*Salvia mohavensis*) are marked with two dagger symbols (††).

All specimens cited are at the University of Arizona Herbarium (ARIZ) unless otherwise indicated by the abbreviations for herbaria at Cabeza Prieta National Wildlife Refuge (CAB), Organ Pipe Cactus National Monument (ORPI), and the standardized abbreviations for herbaria (Thiers 2014). All photos and scans are by Sue Rutman unless otherwise stated and botanical illustrations are by Lucretia Breazeale Hamilton (1908–1986) unless otherwise stated. Descriptions and keys pertain to taxa and populations as they occur in the flora area.

Table 1. Local distributions and growth forms of Fagaceae, Fouquieriaceae, Gentianaceae, Geraniaceae Grossulariaceae, Koeberliniaceae, Krameriaceae, Lamiaceae, Linaceae, Loasaceae, and Lythraceae. † = Modern species and fossil specimen(s); †† = fossil no longer present; * = non-native species established in the flora area; ** = non-native species not established in the flora area. OP = Organ Pipe Cactus National Monument; CP = Cabeza Prieta National Wildlife Refuge; TA = Tinajas Altas Region. SU = Summer/warm-season ephemerals; WI = winter-spring/cool-season ephemerals; NS = non-seasonal ephemerals; AP = facultative annuals or perennials; PR = perennials.

Species	**Region**			**Growth Form**				
				Ephemerals			Facultative annuals or perennials	Perennials
	Organ Pipe	Cabeza Prieta	Tinajas Altas	Summer	Winter	Non-seasonal		
FAGACEAE								
†*Quercus turbinella*	OP							PR
FOUQUIERIACEAE								
†*Fouquieria splendens*	OP	CP	TA					PR
GENTIANACEAE								
Eustoma exaltatum	OP							PR
Zeltnera arizonica	OP					NS		
GERANIACEAE								
**Erodium cicutarium*	OP	CP	TA		WI			
†*Erodium texanum*	OP	CP	TA		WI			
Geranium carolinianum	OP				WI			
GROSSULARIACEAE								
Ribes quercetorum	OP							PR
KOEBERLINIACEAE								
†*Koeberlinia spinosa*	OP	CP	TA					PR
KRAMERIACEAE								
Krameria bicolor	OP	CP	TA					PR
†*Krameria erecta*	OP	CP	TA					PR
LAMIACEAE								
Agastache wrightii	OP							PR
†*Condea albida*	OP	CP	TA					PR
†*Hedeoma nana*	OP	CP						PR
†*Monardella arizonica*	OP		†TA					PR
Salvia columbariae	OP	CP			WI			
††*Salvia mohavensis*	OP		TA					PR
†*Salvia pinguifolia*	OP							PR
***Salvia reflexa*	OP				WI			
Salvia vaseyi		CP						PR
Scutellaria mexicana	OP	CP	TA					PR
Tetraclea coulteri	OP	CP						PR
Teucrium cubense	OP	CP				NS		

Teucrium glandulosum	OP	CP	TA					PR
LINACEAE								
**Linum bienne*	OP				WI			
LOASACEAE								
Eucnide rupestris	OP	CP				NS		
Mentzelia affinis	OP	CP			WI			
Mentzelia desertorum		CP	TA		WI			
Mentzelia involucrata	OP	CP			WI			
Mentzelia isolata	OP			SU				
Mentzelia longiloba	OP	CP	TA		WI			
Mentzelia puberula		CP	TA				AP	
Petalonyx linearis	OP		TA					PR
Petalonyx thurberi	OP	CP						PR
LYTHRACEAE								
***Punica granatum*	OP							PR

FAGACEAE – Beech Family

Nearly worldwide; 7 genera, 670 species.

Quercus – Oaks

Trees and shrubs. Mostly northern hemisphere, not in deserts except sometimes at desert edges; 400 species.

Quercus turbinella Greene

[*Q. ajoensis* C.H. Muller. *Q. turbinella* subsp. *ajoensis* (C.H. Muller) Felger & C.H. Lowe]

Scrub oak; *encinillo*. Figure 2.

Shrubs or trees to 8 m tall. Bark gray, rough and fissured on trunk and larger limbs. Leaves evergreen or ultimately deciduous in late spring–early summer during extreme drought. Leaves alternate, often 1–3.5 (5) cm long, broadly oblong to ovate or rounded, tough, often glaucous bluish-green, mostly glabrous above and glabrate below; margins with spine-tipped teeth or leaves sometimes entire, especially in shade. Flowers unisexual, wind pollinated, small and inconspicuous, without petals; male flowers many in pendulous catkins; female flowers solitary or in small clusters. Flowering in April, the small acorns ripening in summer. Acorns partially surrounded by a cup, annual, and on stalks (peduncles) often to 1.5+ cm long.

Ajo Mountains in Alamo and Arch canyons, Bull Pasture, and widespread at higher elevations. In Alamo Canyon and along the Bull Pasture Trail there are small groves of trees with well-formed, often single trunks. One tree in Alamo Canyon had a trunk nearly 1 m in diameter, and in such places there is extensive oak-leaf litter. Some of these trees died as a result of the extended drought of 2001–2002. At higher elevations on the mountain these oaks are shrubs, often growing among rocks. The nearest known population is to the north in the Sand Tank Mountains.

This oak has been in the Ajo Mountains for at least 32,000 years. There are numerous late Wisconsin and early Holocene records for *Quercus turbinella* throughout sub-Mogollon Arizona mountains (Betancourt et al. 1990). This oak ranges from California to Utah, Texas, and northern Mexico including Baja California and northernmost Sonora. As the common name "scrub oak" indicates, it is generally a shrub. The tree-sized stature of *Q. turbinella* in Alamo Canyon is notable. Elsewhere tree-sized individuals of *Q. turbinella* are usually rare, e.g., near the San Pedro River near

Winkelman in Pinal County (Phil Jenkins, pers. comm. to Felger, 2005). There are only a few places, such as the Ajo Mountains, and in the Lower Gila Box along the Gila River in southwestern New Mexico, where more than an occasional individual reaches tree size (more than 5 m tall with a well-formed trunk). Like so many oaks, these giants likely share genes with other, related white oaks (sect. *Quercus* = *Leucobalanus*).

Figure 2. *Quercus turbinella*. (A) By Lucretia Breazeale Hamilton. Alamo Canyon above Alamo Well: (B) New shoots and flowers, 12 Mar 2005; (C) Galls, 12 Mar 2005; (D) 28 Feb 2009; (E) 7 Feb 2013.

Quercus turbinella in the Ajo Mountains was a potential source of edible acorns, which probably were ground into meal and consumed as cakes or gruel.

The scrub oak in the Ajo Mountains and nearby southern Arizona mountains was named as a distinct species, *Quercus ajoensis*, and also as a subspecies of *Q. turbinella*. Nixon (1997) in the Flora of North America recognized *Q. ajoensis* as a distinct species, as did Spellenberg (2001) for the oaks of the U.S.–Mexico border region. For the oaks of Arizona, Landrum (1993) treated *Q. ajoensis* as a synonym of *Q. turbinella*. The distinctions are technical, involving pubescence, and are not easy to decipher. Treating *Q. ajoensis* as a subspecies of *Q. turbinella*, as Felger and Lowe (1970) did, may make sense biologically but is not practical. Among the 400 species of oaks around the world, too often one finds continuous, indistinct boundaries between the species. Distinguishing subspecies or varieties among oaks can be a futile exercise, like constructing a taxonomic house of cards and inviting dissension among botanists. Botanical taxonomy can be contentious and political (see *Acacia*, Fabaceae, in the present flora series), but it is the essential poetry of the diversity of life.

OP: Alamo Canyon, 19 Mar 1933, *Shreve 6200*. Along wash in main fork of Alamo Canyon, tree with scaly thin gray bark and sprawling branches, 2675 ft, 15 Aug 1952, *Muller 9519 & Tucker* (isotypes of *Q. ajoensis*, ARIZ, NMC, NY, ORPI). Bull Pasture Trail, 3000 ft, *Bezy 25 Oct 1964*. Arch Canyon, canyon bottom, 3 May 1978, *Bowers 1303*. Upper reaches of Alamo Canyon, bottom of ravine, 30 Mar 1989, *Baker 7601* (ASU). †Alamo Canyon, twigs, leaves, acorns, 8130 to 32,000 ybp (6 samples). †Montezuma's Head, twigs, leaves, acorns, 13,500 to 21,840 ybp (4 samples).

FOUQUIERIACEAE – Ocotillo Family

A family of one genus.

Fouquieria – Ocotillo

Spiny shrubs or trees. Dry regions of Mexico, 11 species, with 1 extending into the USA. Includes the boojum tree or *cirio*, *Fouquieria columnaris*. The system of branching and spine formation in *Fouquieria* is unusual but not entirely unique. For example, convergence occurs among *Sesamothamnus* in the Pedaliaceae, native to eastern and southern Africa, and *Fouquieria*. Some *Sesamothamnus* and *Fouquieria* have similar leaf-spine formation, and some of the species of *Sesamothamnus* approach some Mexican *Fouquieria* species in gross morphology including growth form.

Fouquieria splendens Engelmann subsp. **splendens**
Ocotillo; *ocotillo*; melhog. Figure 3.

Unique long-lived desert "shrubs" often 2–3+ m tall, with slender, few-branched, wand-like spiny branches arising from a very reduced trunk or more often trunkless. Long shoots produced during warmer weather and high soil moisture, such as during summer rains and especially in the wake of a fall hurricane-fringe storm, or occasionally in spring. Long shoots with alternate, widely spaced nodes, these leaves with well-developed petioles, which form a rigid spine from the petiole and leaf-blade midrib (Figure 3C). Short shoots in axils of the spines, their internodes extremely reduced and not apparent, with leaves clustered and sessile, appearing at almost any time of year following a ground-soaking rain except during freezing weather, quickly becoming yellow and shedding as the soil dries or with freezing weather (Figure 3A and F). Inflorescences of densely flowered panicles at branch tips, often (6) 19–24 cm long, with conspicuous leafy bracts falling at anthesis. Flowers bright red-orange, the corolla fused below into a tube, with 5 reflexed lobes. Flowering mostly late February–March, attracting hummingbirds; fruits ripening in late spring. Fruit a capsule, with 6–15 flat, papery-winged seeds.

Ubiquitous across the region on desert flats and rocky slopes to the summits of most of the desert peaks, including the crestline of the Ajo Mountains, and also on the Pinta Sands and locally on sand flats.

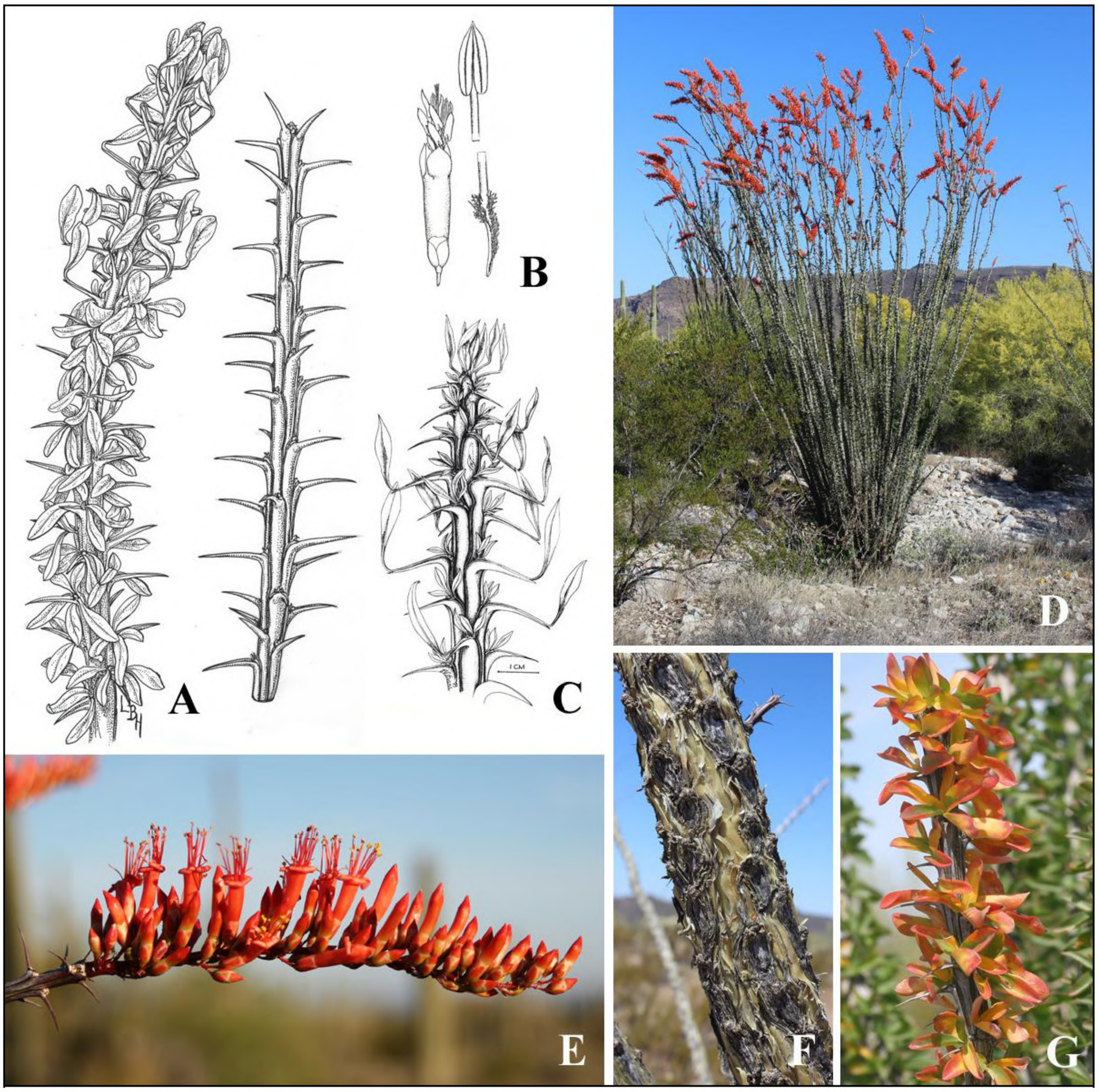

Figure 3. *Fouquieria splendens* subsp. *splendens*. (A) By Lucretia Breazeale Hamilton. (B) By Frances E. Runyan. (C) By Nancy Evans. (D) Little Ajo Mountains, 6 Apr 2015. (E) Alamo Canyon, 7 Apr 2005. (F) Old stem, southern Ajo Mountain Drive, 17 May 2015. (G) Drought-stressed leaves prior to shedding, near Victoria Mine, 1 Apr 2010.

Widespread across the Sonoran, Mojave, and Chihuahuan deserts to elevations well above the deserts; two other subspecies occur in the Chihuahuan Desert in Mexico (Henrickson 1972).

The oldest Sonoran Desert records for ocotillo are from the late Holocene. Considering the ecological amplitude (range of habitats) and wide geographic range of this species, its apparent late arrival and rarity in packrat midden assemblages are somewhat surprising.

Nectar can be sucked from the flower base for a trailside snack (Barrows 1900; Felger et al. 1992). The flowers were steeped in water for a beverage (Bean & Saubel 1972). Nectar pressed from the flowers hardens when dry and was chewed as a delicacy (Castetter & Bell 1942). The Cahuillas parched and ground the seeds to make a gruel or cakes (Bean & Saubel 1972). Ocotillo was used as a framework for traditional Hia-Ced brush houses (Betty Melvin in Zepeda 1985: 34). Living fences

made from the stems (Bean & Saubel 1972; Castetter & Bell 1942) continue to be popular in the region.

OP: Growler Well, *Nichol 27 Apr 1939* (ORPI). Growler Mts, foothills, 16 Apr 1952, *Parker 7986.* Quitobaquito, 29 Mar 1988, *Felger 88-132.* Trail from The Cones to Mount Ajo, 4090 ft, 10 Apr 2005, *Felger* (observation). †Puerto Blanco Mts, on ridge, spines, 130 & 3440 ybp.

CP: Observations: Agua Dulce Mts, Cabeza Prieta Tanks, Charlie Bell Pass, Granite Pass Tank, Halfway Tank, NE of Tule Well, 12–15 Jun 1992, *Felger.* 100 m N of Camino del Diablo 5.5 mi ENE of Papago Well, 300 m, granitic hill with crude rock-walled circle at summit used by smugglers as a lookout, many stems with leafy, young long-shoots, flowers bright red-orange, common and widespread, 26 Mar 2010, *Felger 10-119.*

TA: Camino del Diablo, SE of Raven Butte, 25 Oct 2004, *Felger 04-15.* Tinajas Altas Mts, near the summit, 26 Oct 2004, *Felger* (observation). †Butler Mts, stem fragment with spines, 740 ybp.

GENTIANACEAE – Gentian Family

Annual to perennial herbs, mostly glabrous (those in the flora area). Leaves mostly opposite, simple, usually entire, often clasping the stem; stipules none. Flowers usually bisexual and radial, often showy, 5-merous (those in the flora area), the calyx persistent, the calyx and corolla each united below. Fruit a capsule; seeds minute, and numerous.

Worldwide; 88 genera, 1675 species. Mostly in moist, cool, often montane, arctic or alpine habitats; few in deserts and hot climates. Apart from two other *Zeltnera* species at the desert edge, ours are the only gentians in the Sonoran Desert.

1. Leaves glaucous blue-green; corollas white, the tube 2–3 cm long, anthers not twisting ..... **Eustoma**
1. Leaves green, not glaucous; corollas bright pink, the tube 1–2 cm long, the anthers twisting after the flowers open..... **Zeltnera**

Eustoma – Prairie Gentian, Catchfly Gentian

This genus has a single species.

Eustoma exaltatum (Linnaeus) Salisbury ex G. Don subsp. **exaltatum**
Catchfly prairie gentian; *hawañ ta:tad.* Figure 4.

Annuals or short-lived perennials. Stems erect and leafy, 30–75 cm tall; herbage glaucous blue-green, winter deciduous. Leaves opposite, 2–6 cm long, the lowest leaves short petioled, the stem leaves sessile, clasping, and often fused basally, obovate to broadly elliptic or oblong, relatively thick and firm, the margins entire. Inflorescences of panicles. Flowers showy, 2.5–4 cm long, with mostly long pedicels. Calyx deeply cleft, the lobes slender and keeled. Corollas shiny cream-white or very pale blue, with 5 large, erect to partially spreading lobes. Anthers yellow. Capsules 1–1.5 cm long, oblong, thickened and tough, rough-surfaced, and many-seeded. Seeds 0.5 mm wide, rounded, deeply pitted, gray, and iridescent. Flowering during the warmer months.

Locally common in alkaline and saline wet soil at Burro, Quitobaquito, and Williams springs. Not known elsewhere in the flora area.

Three subspecies, southern USA to northern South America, and the West Indies. Across much of its range the corollas of *Eutoma exaltatum* are variously blue to purple. Subspecies *exaltatum* with white petals is known as forma *albiflorum* Benke. Selections of subsp. *exaltatum* and *E. exaltatum* subsp. *russellianum* are grown as garden plants and there are a number of horticultural selections.

OP: Quitobaquito: *Mearns 7 Feb 1894* (US); *Harbison 27 Nov 1939* (SD); 17 Mar 1945, *Darrow 2401*; Wet slopes near springs, flowers whitish or very pale blue, 25 Nov 1972, *Pinkava 9995* (ASU). Williams Spring, locally common at springs seeping from edge of low hills, 13 Sep 1986, *Felger 86-268*.

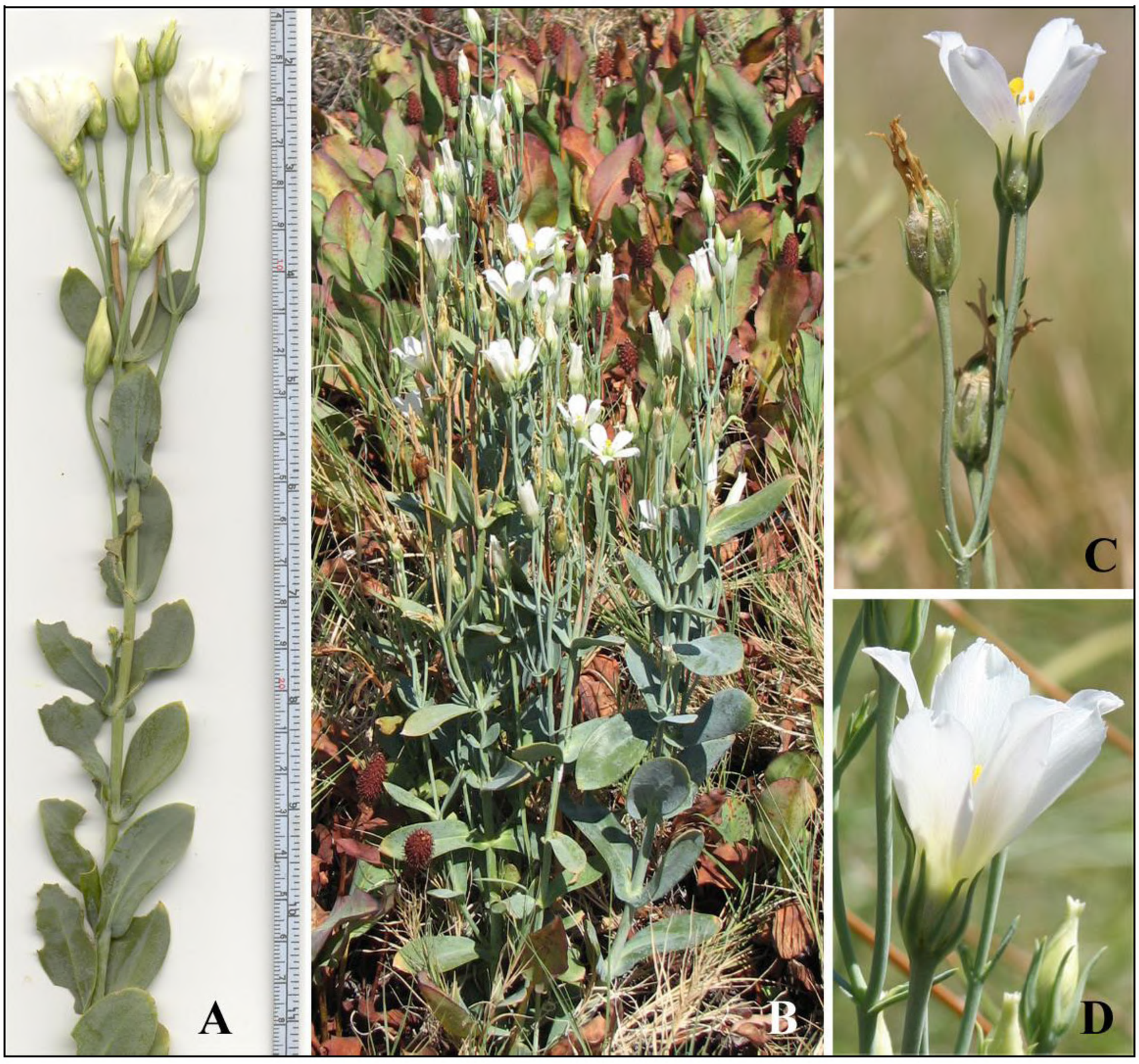

Figure 4. *Eustoma exaltatum*. Quitobaquito: (A) 11 Sep 2008; (B) 10 Sep 2007; (C & D) 13 Sep 2006.

Zeltnera – Centaury

Annuals. North and South America; 25 species. A genus segregated from *Centaurium*.

Zeltnera arizonica (A. Gray) G Mansion

[*Centaurium arizonicum* (A. Gray) A. Heller. *C. calycosum* (Buckley) Fernald var. *arizonicum* (A. Gray) Tidestrom]

Arizona centaury. Figure 5.

Ephemerals, 12–80 cm tall, the stems erect, single to much-branched; herbage green. Leaves sessile, 1–4 cm long, lanceolate or oblanceolate to ovate or obovate, with entire margins. Inflorescences of terminal cymes. Flowers showy; pedicels often about as long as the calyx tube. Calyx lobes linear, separate nearly to the base. Corollas bright pink, 5-lobed, the lobes 7–12 mm long and spreading, the throat yellow-green (elsewhere in southern Arizona the corollas are sometimes white). Filaments and style white, the anthers and stigma yellow; anthers twisting spirally after dehiscence. Capsules 1 cm long, oblong, the walls thin and smooth. Seeds 0.35–0.45 mm long, ovoid, minutely reticulate and pitted, gray, and iridescent. Flowering March–November.

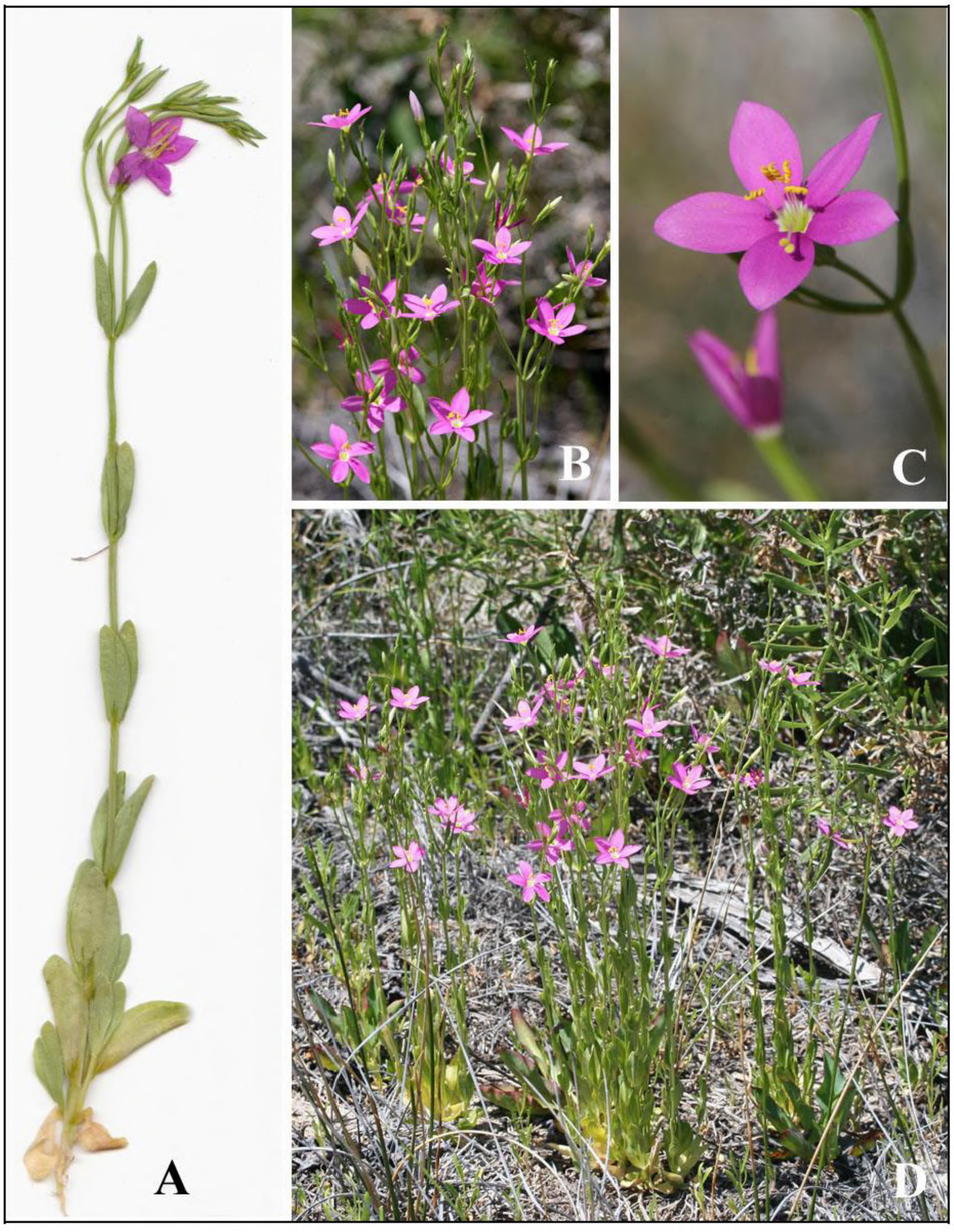

Figure 5. *Zeltnera arizonica*. Quitobaquito: (A) 3 May 2008; (B–D) 5 Mar 2005.

Locally abundant in alkaline and saline wet soil at seeps and springs from Quitobaquito to Williams Spring. Not known elsewhere in the region.

Alkaline wetlands in southwestern USA and northern Mexico.

OP: Quitobaquito: *Fouts 15 Jun 1949* (ORPI); 4 May 1978, *Bowers 1308*; 3 Sep 1980, *Nabhan 146*; 23 Jul 1986, *Felger_86-212*; 23 May 1991, *Baker 8357* (ARIZ, ASU). Williams Spring, 13 Sep 1986, *Felger 86-272*.

GERANIACEAE – Geranium Family

Ephemerals (those in the flora area; perennials and shrubs elsewhere). Leaves opposite, with stipules. Inflorescences umbellate or cymose. Flowers radial, the sepals and petals 5 and separate.

Fruit a capsule, beaked and distinctive by its elastic dehiscence and separation of the segments (mericarps).

Both hemispheres, largely tropical and temperate, especially Africa; 14 genera, 730 species. The garden and greenhouse geraniums belong to the genus *Pelargonium*. Ornamental geraniums are sometimes cultivated in Sonoran Desert gardens but they suffer from the extreme heat of summer and are frost sensitive.

1. Flowers with 5 functional stamens (with anthers); fruits including the beak (2.6) 3–5 cm long; widespread..... **Erodium**
1. Flowers with 10 functional stamens; fruits including the persistent style column to 2.5 cm long; Ajo Mountains..... **Geranium**

Erodium – Stork's bill

Winter-spring ephemerals. First leaves in a basal rosette. Flowers lavender-pink. The long, corkscrew-like beak on each fruit segment uncoils when moistened and screws the sharp-pointed and heavier seed-bearing end into the ground.

Mostly Old World; 75 species. Several are important forage plants and some Old World perennials are cultivated as ornamentals in temperate regions, especially in rock gardens. Young plants of the two Sonoran Desert species were eaten as greens, fresh or cooked, by the Cahuillas and others (Bean & Saubel 1972; Hodgson 2001).

1. Leaf blades pinnately dissected, much more than twice as long as wide, the petiole shorter than the blade..... **Erodium cicutarium**
1. Leaf blades ovate to 3–lobed or 3–parted, less than twice as long as wide, the petiole longer than the blade..... **Erodium texanum**

***Erodium cicutarium** (Linnaeus) L'Héritier ex Aiton

Filaree, heron's bill, stork's bill; *alfilerillo*; hoho'ibad. Figure 6.

Stems sometimes to 30+ cm, usually much shorter or essentially stemless (dwarfed rosette plants). Herbage with glandular and non-glandular white hairs, the glands minute. Leaves pinnatifid, mostly twice divided, much longer than wide, the blades 2–15+ × 0.8–4 cm, the petioles 1.8–7.5 cm long. Umbels (1) 3–7-flowered. Flowers 11–14 mm wide, the petals lavender-pink, readily falling, slightly longer than the sepals. Fruiting sepals 5–6.5 mm long. Beak of fruits 2.7–3.8 cm long. During highly favorable conditions the plants occasionally reach 2 m across with lower leaves to 27 cm long, peduncles 8–14 cm long, and fruit beaks 3.5–4.5 cm long.

Widely scattered and thoroughly established across the flora area; washes, gravelly flats, bajadas, rocky slopes to higher elevations, and especially disturbed habitats such as roadsides.

Widespread in the Sonoran Desert. Native to the Mediterranean region, widely naturalized and weedy in non-tropical regions worldwide.

OP: Alamo Canyon, *Nichol 14 Mar 1939*. Growler Canyon (E of Bates Well), 19 Mar 1975, *Lehto L18312* (ASU). Aguajita Wash, 3 Mar 1992, *Felger 92-121* (ARIZ, DES). Quitobaquito, 6 Apr 1988, *Felger 88-279*. Trail above Bull Pasture, 15 m below crestline, 4090 ft, 10 Apr 2005, *Felger 05-296*.

CP: San Cristobal Wash, 20 Mar 1992, *Harlan 19*. Charlie Bell Pass, 3 Apr 1992, *Whipple 3917*. Redtail Tank, *Griffin 24 Feb 1995* (CAB).

TA: Coyote Water, 21 Feb 2005, *Felger 05-143*. Tinajas Altas Mts, above the tinajas, 19 Mar 1998, *Felger* (observation).

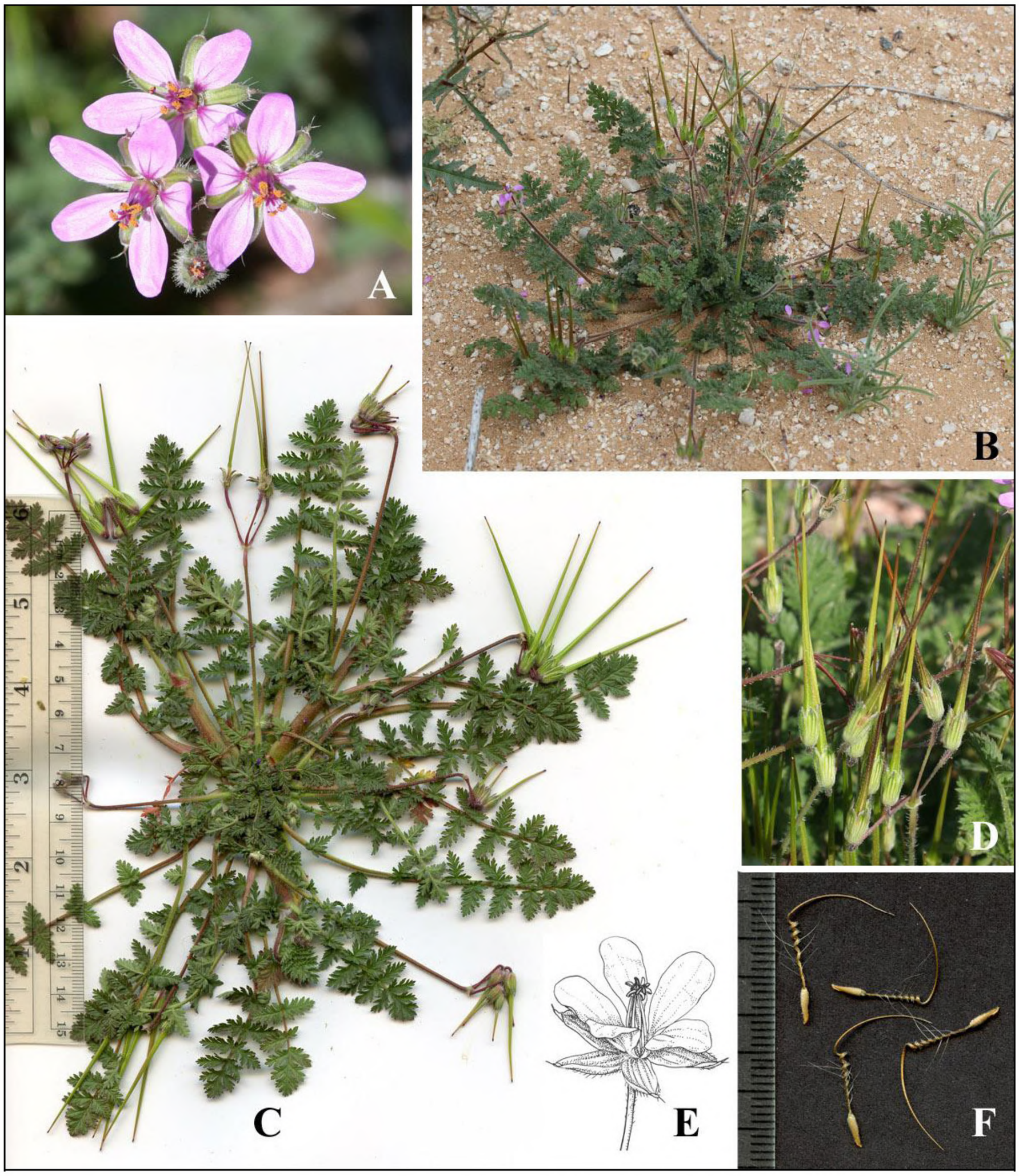

Figure 6. *Erodium cicutarium.* (A) Estes Canyon, 2 Mar 2008. (B) Ajo, 29 Dec 2014. (C) Dunes 37 km SW of Sonoyta on Mex Hwy 8, Sonora, 6 Feb 2014. (D) Near Mex Hwy 8, Sierra Los Tanques, Sonora, 27 Mar 2010. (E) By Lucretia Breazeale Hamilton. (F) N-facing slope of North Puerto Blanco Mts, W of Dripping Springs, 15 Mar 2015.

Erodium texanum A. Gray
Texas filaree, desert stork's bill. Figure 7.

Stems sometimes reaching 25+ cm long, but usually much shorter or essentially stemless. Herbage with small, coarse white hairs, not glandular. Petioles 10–42 mm long, leaf blades 9–21 mm long, ovate to heart-shaped or rounded in outline, usually 3-lobed or parted, the margins toothed; opposite leaves in a pair tend to be unequal in size. Umbels 2–3-flowered. Petals pink-purple,

readily falling, longer than the sepals. Fruiting sepals 5.5–9 mm long. Beak of fruit (2.6) 3.2–5 cm long.

Figure 7. *Erodium texanum*. (A) Valley of the Ajo, W of mile 60, Hwy 85, 16 Mar 2008. (B) Coffeepot Mountain, Sikort Chuapo Mountains, Maricopa Co., 26 Feb 2005. (C) N-facing slope of North Puerto Blanco Mts, W of Dripping Springs, 15 Mar 2015. (D) Kuakatch Wash near Hwy 85, 5 Feb 2005. (E) Slovan Well, Crater Range, Maricopa Co., 22 Jan 2014.

Widespread; washes, bajadas, plains, sandy flats, and sometimes on dunes. Its history in the Tinajas Altas Region extends to 10,400 years.

Southeastern California to southwestern Utah and Texas to northern Mexico including Baja California, northern Sonora, and northern Chihuahua.

OP: Grass Canyon, *Jackson 3 Mar 1965* (ORPI). Pozo Nuevo, 30 Mar 1978, *Bowers 1102* (ORPI). Dripping Springs, 30 Jan 1986, *Phillips_86-8* (ORPI). W side of Sierra Santa Rosa, 12 Mar 2003, *Felger 03-335*.

CP: Near Tule Well, 19 Mar 1992, *Yeatts 3229* (CAB, DBG:KHD). 0.2 mi W. of San Cristobal Wash, 11 Apr 1992, *Harlan 151*. 2 mi W of ORPI boundary on road from Bates Well to Papago Well, 31 Jan 1992, *Felger* (observation). Pinta Sands, 11 Apr 1993, *Felger 93-398*.

TA: Camino del Diablo, SSE of Raven Butte, 20 Feb 2005, *Felger* (observation). †Butler Mts, fruit, 10,360 ybp. †Tinajas Altas, fruit, 8970 ybp.

Geranium – Cranesbill

Annual and biennial herbs. Worldwide; 400 species.

Geranium carolinianum Linnaeus

Carolina crane's bill, Carolina geranium. Figure 8.

Spring ephemerals. Plants cespitose or with stems to about 50 cm long, densely pubescent with short, downward pointing hairs. Lower (larger) leaves 10–15 cm long, the blades 2–6 cm wide, palmately lobed with 5 oblong to wedge-shaped deeply cleft segments. Flowers 1–several in clusters. Pedicels 2–7 mm long; sepals 4–7 mm long and short-awned; petals probably white to pale lavender, about as long as the sepals, the tip notched. Fruit body 2–3 mm long. Seed faintly pitted.

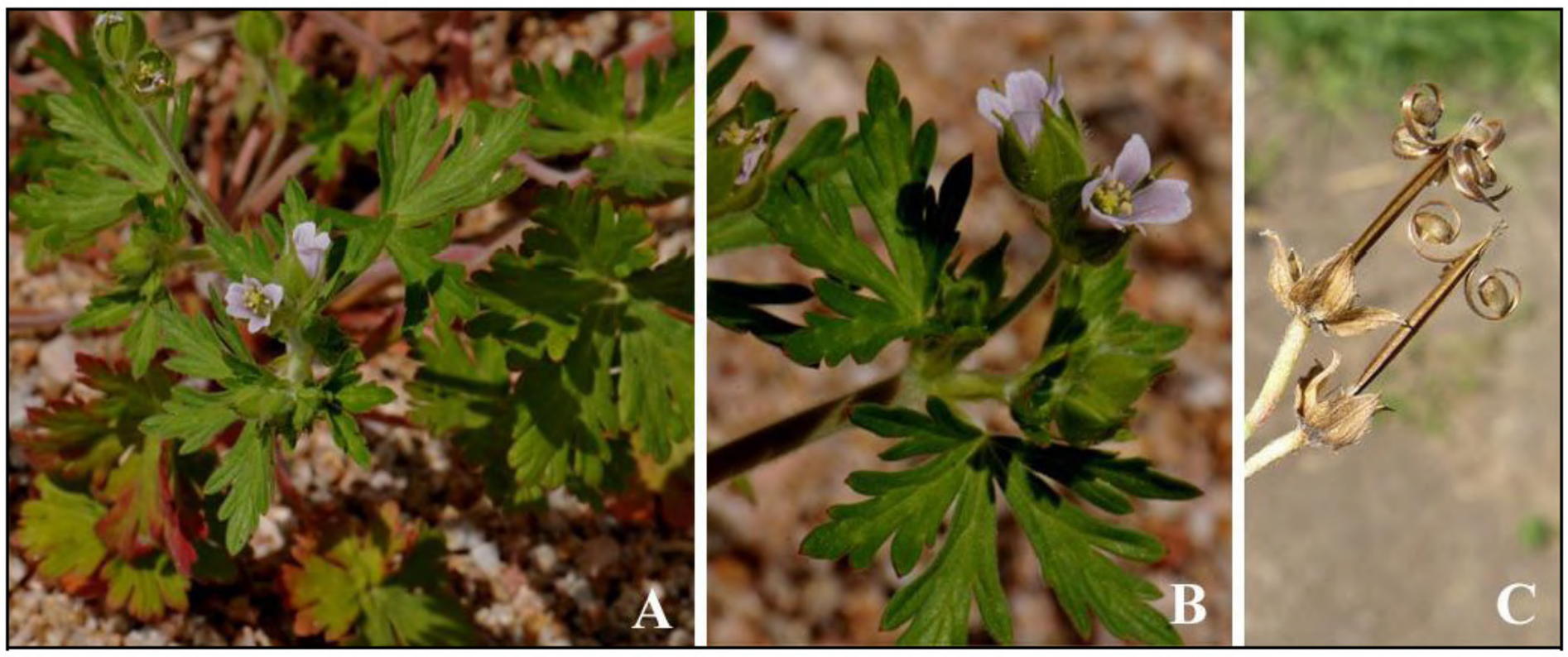

Figure 8. *Geranium carolinianum*. (A & B) Sycamore Creek, State Route 87 at Mt Ord turnoff, Gila Co., 6 Apr 2011, photo by Eugene Sturla (SEINet). (C) El Cerrito, near intersection of Potrero Avenue and BART, Contra Costa Co., CA, 30 Sep 2009, photo by Zoya Akulova (CalPhotos).

Ajo Mountains in canyon bottoms at elevations above about 3200 feet.

Eastward in southern and central Arizona at elevations above the desert. Canada to northern Mexico. Widely naturalized in South America and Eurasia.

OP: Head of Estes Canyon, among rocks in streambed, 3200 ft, 9 May 1979, *Bowers 1711*. Bull Pasture, canyon on N side, along canyon floor, 27 Mar 1985, *Phillips & Phillips 85-9* (MNA).

GROSSULARIACEAE – Gooseberry Family

A family of one genus with 150 species. Shrubs in temperate northern hemisphere and the Andes.

Ribes quercetorum Greene
[*Grossularia quercetorum* (Greene) Coville & Britton]
Oak gooseberry. Figure 9.

Shrubs to 1.5 m tall. Leaf nodes usually with a sharp, slender spine. Leaves alternate, simple, petioled, the blades glandular hairy (stipitate glandular), 1–2 cm wide and about as long, cleft into 3 or 5 segments, the margins toothed. Inflorescences of axillary racemes with 2 or 3 flowers. Flowers 5-merous; tubular, with a yellow hypanthium 2–3 mm long; petals cream-white, with lobes 1 mm long; February. Fruits of fleshy, edible berries 6–9 mm in diameter, shiny and blackish when ripe in late spring.

Figure 9. *Ribes quercetorum*. (A) Above The Cones, Ajo Mts, 22 Oct 2006. (B) Pinnacles National Monument, San Benito Co., CA, 24 Feb 2004, photo © by Keir Morse (CalPhotos).

Ajo Mountains, higher elevations, in canyon bottoms and rocky, often north-facing slopes. This is the closest encounter with the desert for this genus.

Mountains in south-central Arizona, California, and Baja California; it is a species of chaparral and oak woodland.

The fruits are edible, fresh, dried, or cooked and made into jelly (Moerman 1998).

OP: Ajo Mts, deep shaded canyon S of arch, wide crack in N-facing cliff, 18 Feb 1978, *Fay 739*. Trail from Bull Pasture to Mount Ajo, very steep, N-facing slope near crestline of Ajo Mts, 22 Oct 2006, *Rutman 20061022-5*.

HYDROPHYLLACEAE, see **BORAGINACEAE** (Felger et al. 2015).

KOEBERLINIACEAE – Allthorn Family

This family of a single genus includes two species: *Koeberlinia spinosa* in North America and the similar looking *K. holacantha* in the Chaco of Argentina, Bolivia, and Paraguay (Holmes et al. 2008). Koeberliniaceae is a member of the Brassicales, which includes the mustards (Brassicaceae), and is allied with Bataceae and Salvadoraceae, two families of very different appearing plants (Rodman et al. 1993; Stevens 2012; Tucker 2010).

Koeberlinia spinosa Zuccarini var. **tenuispina** Kearney & Peebles
Crucifixion thorn, allthorn; *corona de cristo*. Figure 10.

Spinescent, hardwood shrubs; minutely pubescent. Branches and twigs rigid, the twigs yellowish green, slender, and thorn-tipped. Leaves alternate, scale-like, very quickly deciduous, the plants essentially leafless. Inflorescences of small semi-persistent racemes. Flowers on slender

pedicels, whitish to sometimes pale yellow; sepals 4; petals 4, 4.5 mm long; stamens 8; flowers moderately stinky with a sweet, musty fragrance. Fruits of globose berries with a short stipe, drying capsule-like, 3–3.5 mm diameter, 2–4-seeded. Flowering at least April and June; fruits at least in May.

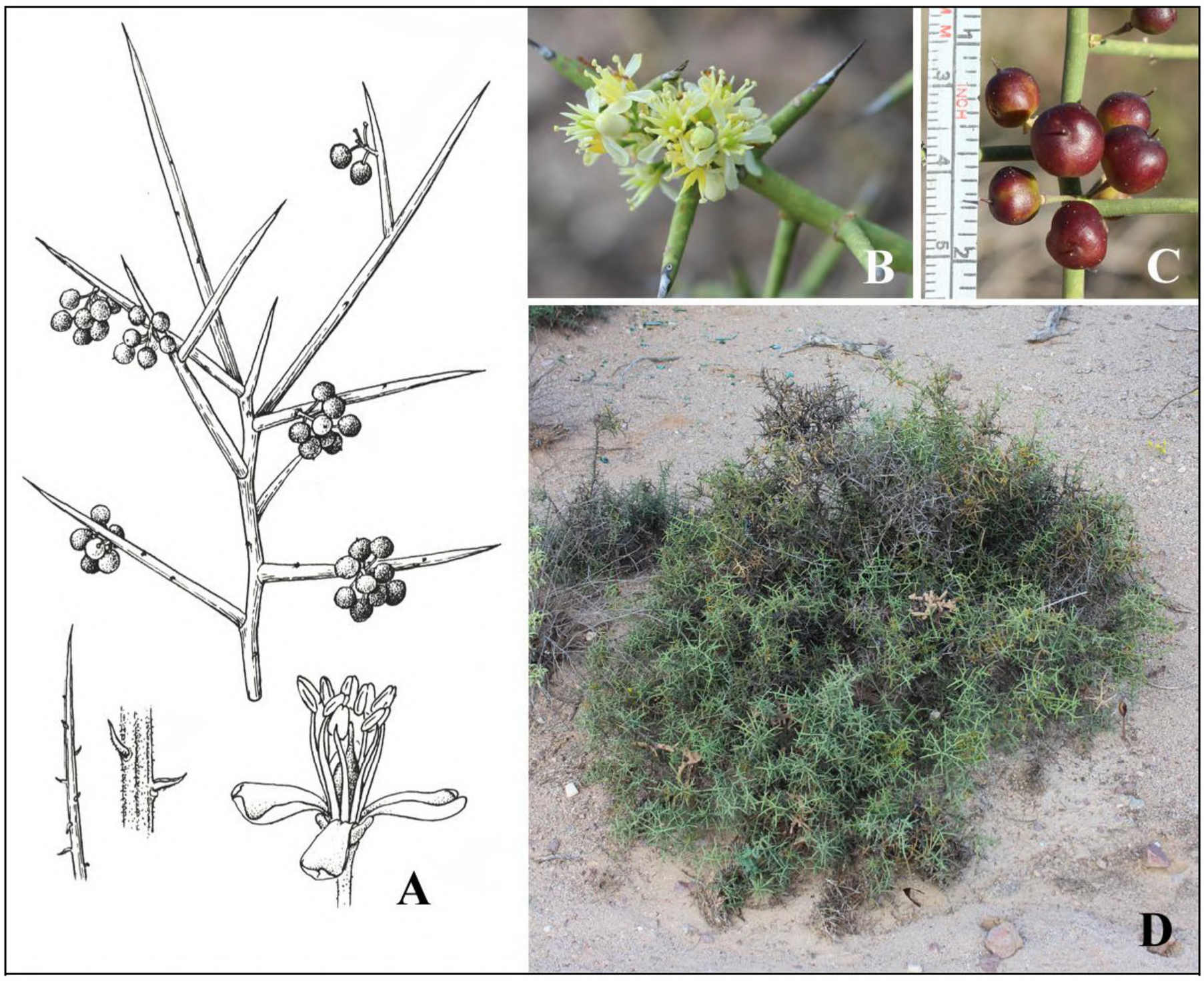

Figure 10. *Koeberlinia spinosa* var. *tenuispina*. (A) By Lucretia Breazeale Hamilton. (B) Eastern foothills of Tucson Mountains, near Grant Road, Pima Co., 24 Jul 2013. (C) Castle Dome Mts, 6 Apr 2014. (D) Gu Vo Road, E of Organ Pipe, Tohono O'odham Reservation, 10 Sep 2013.

Sprawling shrubs often 0.4–1 m tall and more than 1 m across, with thick, radiating lateral roots. Herbage densely pubescent with short, gray hairs, the stems glabrate with age. Stems intricately branched mostly at right angles, straight, slender, and sparsely leaved, the tips often somewhat spinescent. Leaves 5–10 (14) × 1.1–2.4 mm, soon drought deciduous, sessile, linear to oblong, often grayish. Flowers showy, with a strong, sweet fragrance, 1.5 cm wide, solitary or in short racemes with leafy bracts. Sepals bright magenta-purple inside, white hairy outside. Upper petals spear-shaped (narrowly spatulate), separate, bright chartreuse with purplish tips; oil-gland (lower) petals extremely thick, fleshy, slab-like, and dark purple (other colors reported for specimens from elsewhere; Simpson 1989). Fruits more or less globose, 1 cm wide, the spines with a terminal cluster of small barbs. Flowering various seasons.

Occasional plants on a sandy loam flat within 1 km of the northeastern corner of Organ Pipe and in the southeastern part of the Monument near the Mexican border. Common in areas north and east of the Monument, such as the Sand Tank Mountains in the Goldwater Range and Vekol Valley in

the Sonoran Desert National Monument. A single large shrub is known from the Pinacate Region in northwestern Sonora (Felger 2000). It was in the Tinajas Altas Region more than 10,000 years ago.

Holmes et al. (2008) recognized three varieties of *Koeberlinia spinosa*. Var. *tenuispina* is essentially a Sonoran Desert endemic in southwestern Arizona, southeastern California, Baja California, Baja California Sur, and western Sonora nearly to the Sinaloa border. It sometimes becomes a small tree 3–4 m tall on Isla Tiburón and in a few mainland Sonora locations. The hard wood does not float in water and when burned produces copious oily black smoke, which the Seris used in the 19th century to disinfect their houses during epidemics (probably measles) and to prevent diseases after visiting the town of Hermosillo (Felger & Moser 1985). Tea made from the flowers was taken as a remedy for dizziness and intestinal disorders, and tea made with the twigs mixed with *hierba del manso* (*Anemopsis californica*) was taken as a remedy for rheumatism (Felger & Moser 1985).

Var. *wivaggii* W.C. Holmes et al. is essentially a Chihuahuan Desert taxon occurring east of var. *tenuispina* and west of var. *spinosa* of Texas and northeastern Mexico. Var. *tenuispina* is distinguished from the other varieties by its sometimes arborescent habit, longer thorns, young thorns densely puberulent rather than glabrous or minutely puberulent, and slightly longer ovary/fruit stipes, styles, and petals. Although these distinctions may seem minor, they are geographically segregated.

OP: Sonoyta Valley, N of Dos Lomitas, 10 Jun 2011, *Sarah Howard*, photo (at least 2 plants, in flower). 6 mi E of Lukeville, close to international boundary, 135 m, *Conner 26 Mar 2013*.
TA: †Butler Mts, twig, 10,360 ybp.

KRAMERIACEAE – Ratany Family

This family has one genus. Krameriaceae and Zygophyllaceae are the only families in the order Zygophyllales.

Krameria – Ratany, rhatany

Small shrubs, taniferous (high tannin-like content). Hemiparasites; the roots contain red pigment. Leaves alternate, drought-deciduous and simple (those in the flora area); stipules none. Flowers bilateral, mostly purple and attractive; sepals 5 and showy, petal-like and much larger than the petals; petals 5, the 2 lower ones modified as elaiophores—thick, slab-like, fleshy, oil-secreting glandular structures. Stamens 4, the flowers buzz-pollinated with anthers opening by terminal pores. Fruits dry, indehiscent, 1-seeded, and bur-like with slender spines, resembling a miniature sea urchin.

Americas; 18 species (Simpson & Salywon 1999; Simpson et al. 1977, 1978, 2004).

"Probably all the species of the genus are hemiparasites, with the roots forming haustoria upon the roots of a variety of (mostly woody) hosts. The flowers of *Krameria* are nectarless and the rewards provided pollinators are fatty oils produced by the modified external surfaces of the lower two petals, the elaiophores. The pollination syndrome for the plants is an obligate mutualism with female digger bees of the genus *Centris* (Anthophoridae) which use the oils mixed with pollen for their larval food" (Simpson & Salywon 1999: 57; also see Cannon 1910, 1911 and Simpson et al. 1977, 1978). Seedlings lack root hairs and must attach to a root of a host within the first two months of life or perish (Cannon 1911). A similar pollination syndrome is seen with *Centris* bees and *Cottsia* (Malpighiaceae).

1. Branches mostly straight and without knotty spur-branches; spines of fruit with barbs in a terminal cluster; the 3 upper petals distinct (free), their blades near orbicular..... **Krameria bicolor**
1. Branches tough and knotty with many short spur-branches; spines of fruit with barbs along upper part of shaft; the 3 upper petals fused basally, their blades lanceolate..... **Krameria erecta**

Krameria bicolor S. Watson

[*Krameria bicolor* S. Watson (1886) has priority as the correct name for the species first named *K. canescens* A. Gray in 1852, but not *K. canescens* Willdenow ex Schultes 1827, and then renamed as *K. grayi* Rose & Painter (1906, based on the same type as *K. canescens* A. Gray); Simpson 2013.]

White ratany; *cósahui*; edho, he:d. Figure 11.

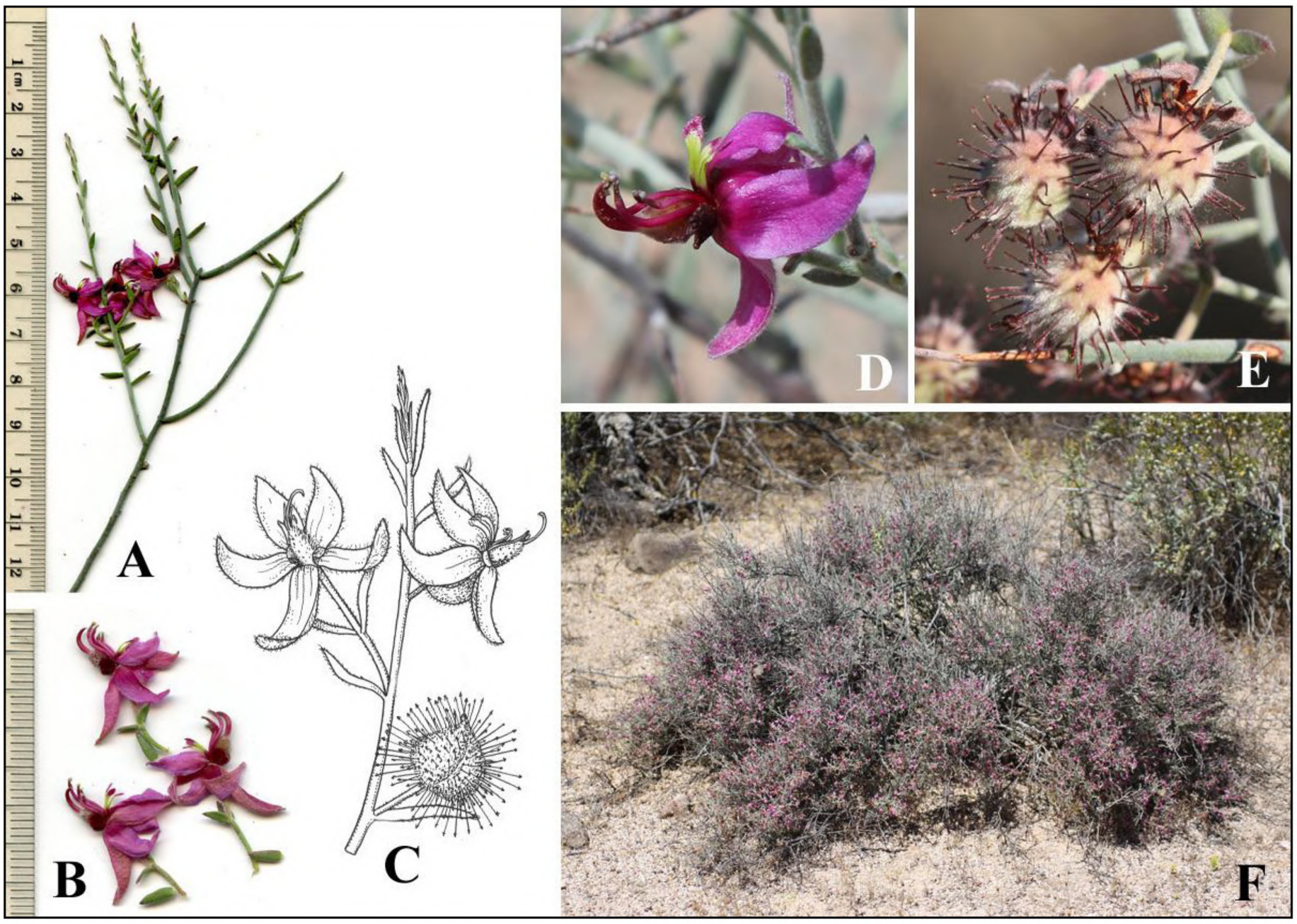

Figure 11. *Krameria bicolor*. (A & B) Dripping Springs, 12 Mar 2015. (C) By Lucretia Breazeale Hamilton. (D) Ajo, 4 Aug 2013. Trail to Victoria Mine: (E) 23 May 2006; (F) 23 Apr 2010.

Sprawling shrubs often 0.4–1 m tall and more than 1 m across, with thick, radiating lateral roots. Herbage densely pubescent with short, gray hairs, the stems glabrate with age. Stems intricately branched mostly at right angles, straight, slender, and sparsely leaved, the tips often somewhat spinescent. Leaves 5–10 (14) × 1.1–2.4 mm, soon drought deciduous, sessile, linear to oblong, often grayish. Flowers showy, with a strong, sweet fragrance, 1.5 cm wide, solitary or in short racemes with leafy bracts. Sepals bright magenta-purple inside, white hairy outside. Upper petals spear-shaped (narrowly spatulate), separate, bright chartreuse with purplish tips; oil-gland (lower) petals extremely thick, fleshy, slab-like, and dark purple (other colors reported for specimens from elsewhere; Simpson 1989). Fruits more or less globose, 1 cm wide, the spines with a terminal cluster of small barbs. Flowering various seasons.

Common and widespread through most of the lowlands of the region, especially in sandy to gravelly soils of washes, plains and bajadas, and sometimes on rocky slopes.

Southeastern California to western Texas and southwestern Utah, and northwestern and north-central Mexico.

The thick roots have had widespread use in the Sonoran Desert as a source of dyes and medicines (e.g., Castetter & Underhill 1935; Felger 2007; Felger & Moser 1985; Felger et al. 1992; Rea 1997). The roots were an important source of reddish-brown to pinkish dye, especially for basketry and fabrics; they were also prepared for cosmetics and as a tanning agent for deer hides. Hia-Ced O'odham women's buckskin dresses were sometimes "made red with a dye made from a small bush which the Mexicans call Cosawi" (Childs 1954: 36). Hia-Ced O'odham women "use edho (a red dry plant) . . . [to] paint their cheeks and lips. . . . Women who paint with these plants are women who dance" (Betty Melvin in Bell et al. 1980: 101). This plant has been used by the Gila River Pimas to treat diabetes and numerous other remedies, such as for diarrhea, upset stomach, stomach sores (ulcers), skin sores, kidney problems, sore throats or bad colds, arthritic pain, and tuberculosis and to facilitate healing, prevent infection, and purify the blood (Rea 1997).

Common and widespread through most of the lowlands of the region, especially in sandy to gravelly soils of washes, plains and bajadas, and sometimes on rocky slopes.

Southeastern California to western Texas and southwestern Utah, and northwestern and north-central Mexico.

OP: 8 mi S of Growler Well, *Nichol 17 Apr 1939*. Alamo Canyon (see Mulroy 1971). 2 mi S of Kuakatch Wash on power line road, 24 Jul 1978, *Bowers 1386*. Senita Basin, 6 Dec 1978, *Hodgson H201* (DES). Quitobaquito, 14 Sep 1988, *Felger 88-446*.

CP: Charlie Bell Well, *Johnson 26 Mar 1960*. Buck Mt Tank, *Duncan 28 Mar 1970* (CAB). Christmas Pass, 13 Apr 1992, *Harlan 271* (CAB). Observations: N side of Sheep Peak, 31 Jan 1992, *Felger*; Pinta Sands, 1 Feb 1992, *Felger*.

TA: Tinajas Altas, canyon below tanks and on rocky slopes, 19 Mar 1998, *Felger* (observation). Camino del Diablo, SE of Raven Butte, 25 Oct 2004, *Felger 04-16*.

Krameria erecta Willdenow ex Schultes
[*K. parvifolia* Bentham]
Littleleaf or range ratany; *cósahui*. Figure 12.

Dwarf shrubs often 0.3–0.5 m tall, with many short, rigid branches, the branches appearing knotty due to many very short spur branches. Herbage densely pubescent and grayish with short whitish hairs. Leaves drought deciduous, 3–9 × 0.8–1.3 mm, sessile, and linear. Flowers showy, 1.5 cm wide, solitary or in short racemes with leafy bracts. Sepals bright magenta-purple inside, white hairy outside. Upper petals expanded above into lavender blades and narrowed below into thick, bright green claws, the claws united below; oil-gland (lower) petals thick and very dark purple. Fruits globose and moderately compressed, 6 mm wide, the spines 3.5 mm long with small barbs distributed along the upper part of the shaft. Flowering various seasons.

Often on rocky soils, also sandy-silty soils; hills and mountains—sometimes to the summits of the drier mountains, bajadas, and rocky-gravelly plains; widely scattered across the flora area. It was in the Tinajas Altas Region more than 8200 years ago.

Southeastern California to southwestern Utah and Texas, and northwestern and north-central Mexico.

OP: Growler Mts, *Crooks 31 Mar 1937*. Pozo Nuevo, 16 Apr 1965, *Bennett 8768* (ORPI). 2 mi W of Bates Well, 30 Mar 1978, *Bowers 1127* (ORPI). Alamo [Canyon] Campground, *Beale 15 Mar 1986* (ORPI). Quitobaquito, 14 Sep 1988, *Felger 88-468*.

CP: Charlie Bell Pass, 3 Apr 1992, *Whipple 3938* (CAB). Pinacate Lava, 15 Sep 1992, *Felger 92-766*. 4.7 mi E of Tule Well, 11 Apr 1993, *Felger 93-439*. Sunday Pass, Sierra Pinta, *Cain 15 Nov 2003*.

TA: Butler Mts, 27 Mar 1983, *Van Devender* (observation). 0.3 mi SE of Tinajas Altas, 22 Nov 2008, *Felger 08-191*. †Butler Mts, leaves, fruits and spines from fruits, 740 & 8160 ybp.

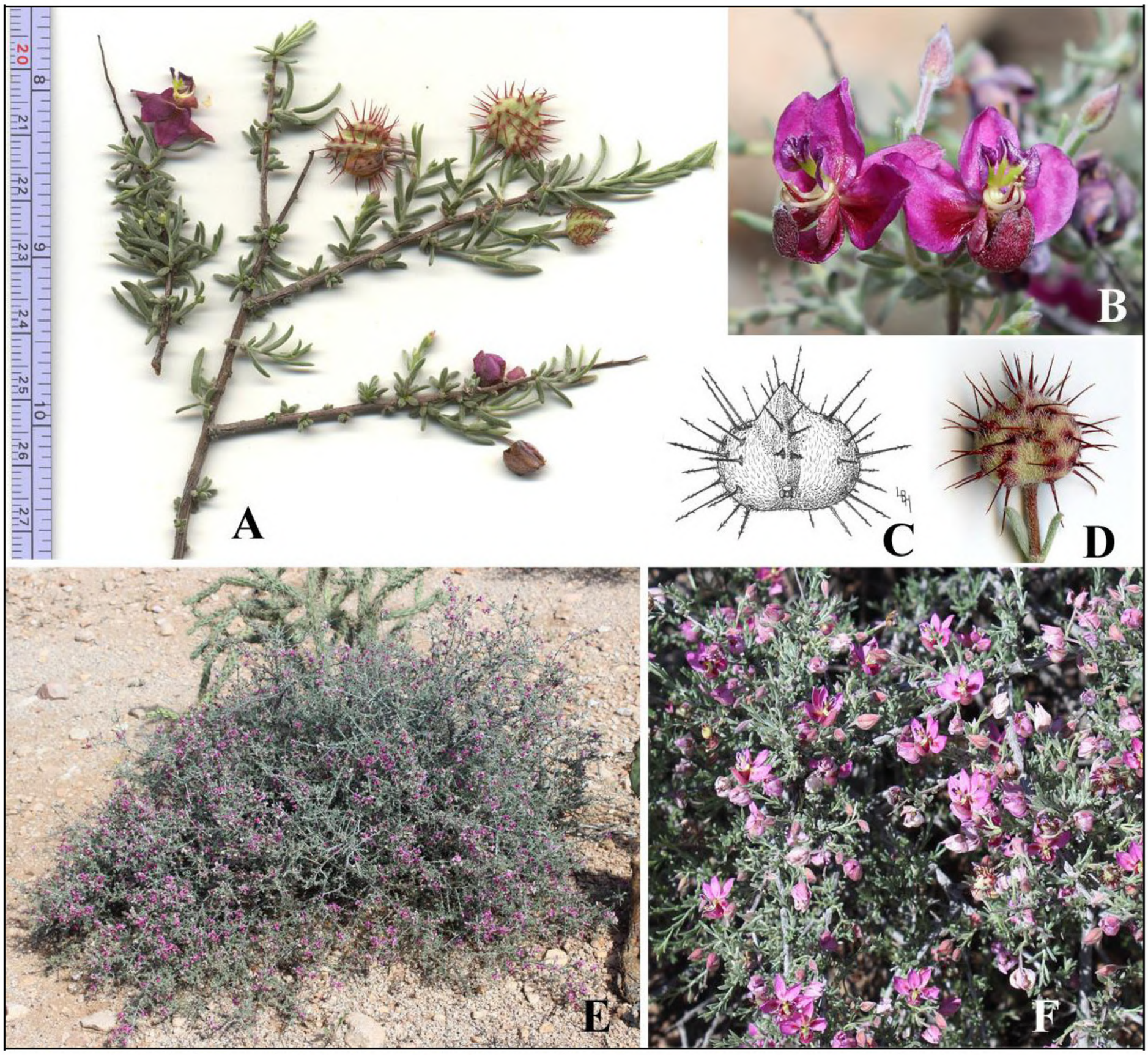

Figure 12. *Krameria erecta*. (A) Bajada E of Growler Mts, 13 Sep 2013. (B) Ajo, 31 Jul 2013. (C) By Lucretia Breazeale Hamilton. (D) Northern Bates Well Road, 4 Aug 2014. (E) On granite, Gunsight Hills, 10 Sep 2013. (F) Foothills E of Pinkley Peak, 8 Aug 2013.

LAMIACEAE (LABIATAE) – Mint Family

Ephemerals, perennial herbs, or shrubs; often aromatic. Stems square (4-angled) or sometimes rounded (terete) in cross section. Leaves opposite, sometimes whorled or in basal rosettes; stipules none. Sepals united into a tube, mostly 2-lipped with 5 lobes or teeth. Corollas bilateral, 5-lobed, mostly 2-lipped, the lower one usually larger. Stamens attached to the corolla tube, 4 and paired, or 2 and sometimes with an additional pair of staminodes. Style often cleft at tip into equal or unequal lobes, or one lobe vestigial. Fruits of 4 nutlets (1-seeded).

Worldwide; 236 genera, 7173 species.

1. Plants herbaceous or mostly so.

2. Spring ephemerals; larger leaves in a basal rosette and pinnatifid, the stem (cauline) leaves greatly reduced; stamens 2..... **Salvia** (in part, including **S. columbariae**)
2. Non-seasonal ephemerals or perennials; leaves not pinnatifid, the stem leaves well developed; stamens 4 (or 2 in **Hedeoma**)

3. Annuals (ephemerals), generally with a small root system; stems rather weak, soon spreading to decumbent..... **Teucrium cubense**
3. Obvious perennials with a well-developed root system; stems mostly firm and upright.

4. Plants glabrous or glabrate except youngest growth and flowers; leaves few-toothed and the larger ones lobed; corollas 18–26 mm long..... **Teucrium glandulosum**
4. Plants pubescent; leaf margins entire, serrated, or toothed; corollas 4–15 mm long.

5.Leaves sessile; corollas 10–15 mm long, white and spotted with violet..... **Monardella**
5. Leaves petioled; corollas 4–15 mm long, white, blue or lavender.

6. Plants stinky; corollas white and pinkish, 4–15 mm long..... **Tetraclea**
6. Plants not stinky; corollas blue or lavender, mostly less than 10 mm long.

7. Leaves mostly 3–6+ cm long; flowers clustered (in verticils) on an interrupted spicate inflorescence; flowers to 10 mm long; stamens 4..... **Agastache**
7. Leaves mostly 1–1.5 cm long; flowers clustered in whorls among leaves in the upper stem nodes; flowers 6–7 mm long; stamens 2..... **Hedeoma**

1. Shrubs or subshrubs, at least the lower branches woody.

8. Plants densely pubescent with branched white hairs..... **Condea**
8. Plants appearing glabrous or with simple (unbranched) hairs.

9. Plants aromatic; leaves mostly more than 2 cm long, the margins minutely to coarsely toothed or scalloped; calyx toothed, not inflated like a bag; stamens 2 ..... **Salvia** (in part)
9. Plants not aromatic or not noticeably so; leaves mostly less than 2 cm long, the margins entire; calyx not toothed, the fruiting calyx inflated like a bag or balloon; stamens 4.
..... **Scutellaria**

Agastache

Perennial herbs. North America and Asia; 22 species.

Agastache wrightii (Greenman) Wooton & Standley
Sonoran giant hyssop. Figure 13.

Herbaceous perennials to about 1 m tall, highly aromatic with abundant glands and short, white hairs. Stems leafy, the leaves mostly 3–6 cm long, prominently petioled; leaf blades lanceolate to ovate-dentate, the margins toothed, bicolored, green above, grayish below; first leaves in a basal rosette and larger than the stem leaves. Flowers clustered (in verticils) on an interrupted spicate inflorescence. Calyx persistent, 4–4.8 mm long, green with white teeth when fresh; corollas blue, extending 4–5 mm beyond the calyx. Stamens 4. Nutlets about 1 mm long.

Known in the flora area from a single locality in Alamo Canyon at 2400 feet, which is an unusually low elevation record for this species. One plant was found in 2013; by spring 2015 it had

perished although several young plants were seen near the mother plant. The nearest known populations are in the Coyote and Baboquivari mountains in Pima County.

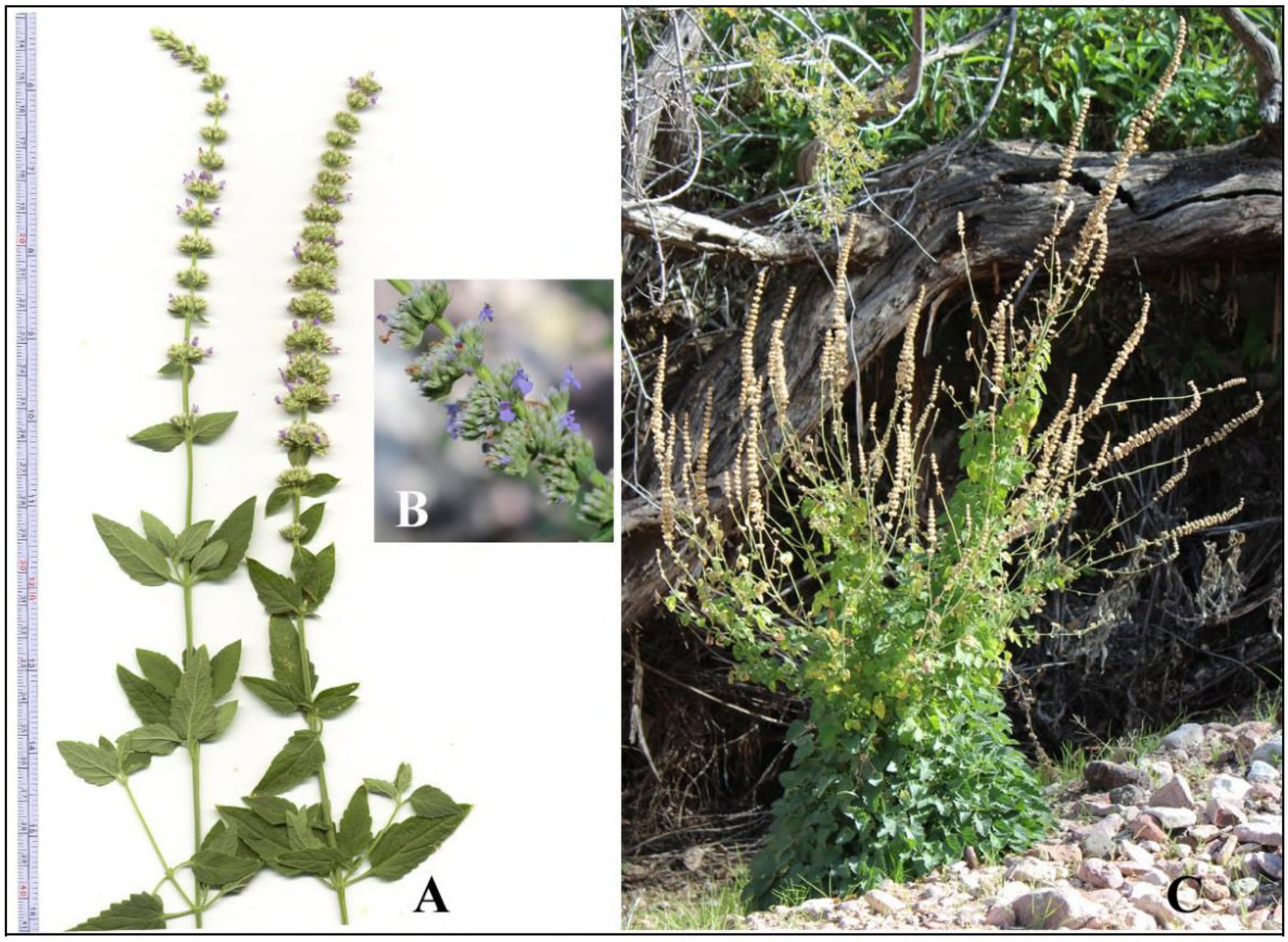

Figure 13. *Agastache wrightii*. Alamo Canyon: (A) 7 Sep 2013; (B) 9 Sep 2013; (C) 1 Feb 2014.

Sonoran giant hyssop is most often seen at 4000–6000 ft along streambeds in riparian oak woodland, where the plants often reach 75–150 cm tall. Flowering August and September. The fresh, aromatic herbage makes a fine tea.

Southern Arizona, southern New Mexico, western Chihuahua, and eastern Sonora.

OP: S fork of Alamo Canyon, 32.06539°, -112.71306°, 2400 ft, **wash bed, single plant, about 1 meter tall, with** *Prosopis velutina, Quercus turbinella, Lycium parishii, Ambrosia ambrosioides, Forestiera, Ambrosia cordifolia, Acaciella angustissima*, 7 Sep 2013, *Rutman 20130907-2* (det. Jim Verrier).

Condea

Trees and shrubs. North and South America; 26 species. A genus segregated from *Hyptis*.

Condea albida (Kunth) Harley & J.F.B. Pastore

[*Condea emoryi* (Torrey) Harley & J.F.B. Pastore. *Hyptis albida* Kunth. *H. emoryi* Torrey. *H. emoryi* var. *amplifolia* I.M. Johnston. *H. emoryi* var. *palmeri* (S. Watson) I.M. Johnston]

Desert lavender; *salvia*. Figure 14.

Shrubs 1–2.5 (3) m tall, with many straight, slender woody stems arising from the base. Branched white hairs generally form a dense vestiture on the leaves, twigs, pedicels, and calyces (especially the tube), and some on corollas and filaments, the foliage thus often whitish. Leaves

ovate, grayish or whitish to olive-green depending on moisture conditions, gradually and tardily drought deciduous; larger leaf blades mostly 1.5–3 cm long, the largest leaves on new primary-growth stems sometimes with blades to 5 cm and petioles to 3 cm. Leaf margins evenly crenulate to broadly toothed. The plants are frost sensitive and often show minor or occasionally severe freeze damage.

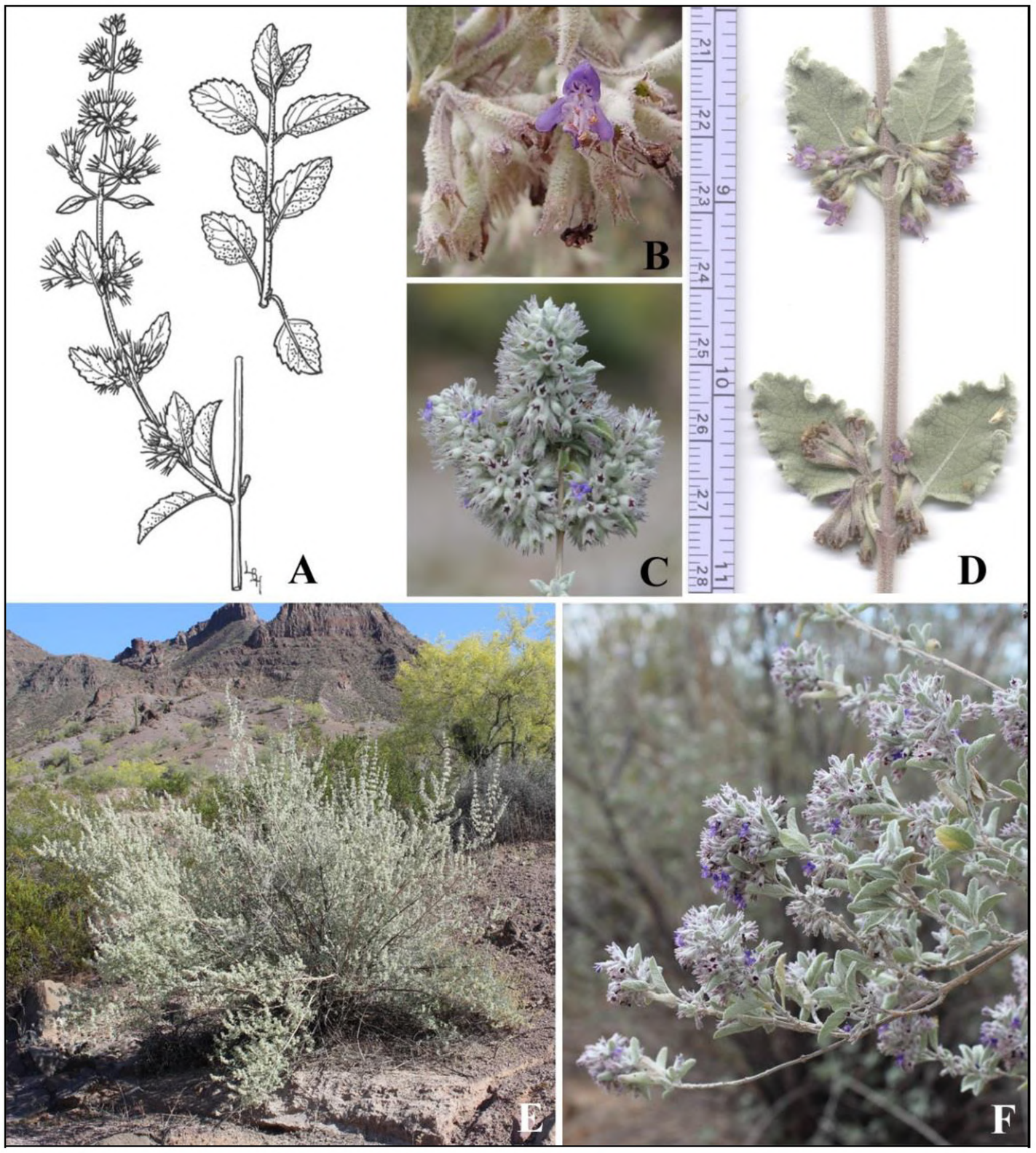

Figure 14. *Condea albida*. (A) By Lucretia Breazeale Hamilton. (B) Tinajas Altas, Yuma Co., 1 Mar 2014, photo by Sue Carnahan. (C) Growler Canyon, 20 Mar 2005. (D) Wash on N side of Little Ajo Mts, 2 Oct 2013. (E) N end of Growler Mts, 29 Mar 2014. (F) Wash on W base of Sierra Cubabi, Sonora, 6 Feb 2014.

Flowers highly fragrant, densely crowded in axillary and terminal clusters or racemes. Pedicels as long as to longer than the calyx. Calyx 4.6–6 mm long, 5 lobed, the lobes slender and purplish. Corollas longer than the calyx, bright lavender-blue and showy against the whitish foliage and calyces. Stamens 4 and fertile, the upper pair shorter. Flowering profusely much of the year except during freezing weather and extreme drought. Nutlets 1.5–2 mm long.

Widespread and common across most of the flora area, mostly in washes, canyons, and rocky slopes to the summits of the larger, drier mountains. It has been part of the regional flora for at least 8700 years.

Southwestern and central Arizona, southern Nevada, and southeastern California to Baja California Sur and northern Mexico to San Luis Potosí, Michoacán, and Guerrero.

We are treating *C. emoryi* (*Hyptis emoryi*) as a synonym of *C. albida* (also see Martin et al. 1998; Felger & Wilder 2012). The Sonoran Desert populations tend to be more densely white-pubescent than those of *C. albida* from non-desert regions farther south in Mexico, but the variation is continuous. The leaves of well-watered desert plants, especially following favorable, warm-season rains, can be much larger, greener (sparsely pubescent), and thinner than dry-season leaves and can resemble leaves of typical non-desert plants (see Smith & Noble 1977a, 1977b). Differences in pedicel length (reportedly longer in *C. emoryi*) and nutlets that are smooth (*C. albida* sensu stricto) vs. "minutely granular-roughened" (*C. emoryi*) are reported as key characters to distinguish them (e.g., Wiggins 1964: 1292–1293). Examination of dozens of specimens at ARIZ indicates that these features do not serve to separate the two taxa. Specimens from Arizona to Jalisco and San Luis Potosí show no discernable distinction in pedicel length and have smooth nutlets, without variation that serves to distinguish them (see Martin et al. 1998; Turner et al. 1995). Several varieties have been described, and across the large geographic range there is considerable variation in leaf shape that may have some taxonomic value.

Desert lavender was an important medicinal plant in the Sonoran Desert, used in combination with other medicinal plants or alone to treat asthma, colds, fever, tooth problems, and hemorrhaging (e.g., Bean & Saubel 1972; Felger & Moser 1985) and it was much appreciated for its fragrance (Felger & Moser 1985; Lumholtz 1912: 205). The Gila River Pimas smoked the leaves as tobacco (Rea 1997). The seeds have been reported as edible (e.g., Kirk 1970; Uphof 1968), but this is probably an error based on misinterpretation of Lumholtz's (1912: 204) use of "*Hyptis*" for *Salvia columbariae*.

OP: N of Dripping Springs, 9 Apr 1941, *McDougall 61*. N of Bates Well, *Tinkham 23 Apr 1942*. Senita Basin, *Warren 10 Apr 1975*. Pozo Nuevo, 11 Feb 1978, *Bowers 1051*. Quitobaquito hills, 24 Oct 1990, *Felger_90-483*. †Puerto Blanco Mts, on ridge, leaves, fruits, 130 to 7580 ybp (12 samples).

CP: Eagle Tank, 13 Jun 1992, *Felger 92-589* (CAB). Agua Dulce Tank, Cabeza Prieta Tanks, 15 Jun 1992, *Felger* (observation). 4.7 mi E of Tule Well, 11 Apr 1993, *Felger 93-440*. Sunday Pass, Sierra Pinta, *Cain 15 Nov 2003*.

TA: 1 mi N of Tinajas Altas, 17 Apr 1948, *Kurtz 1161*. †Butler Mts, twigs, leaves, fruits, 740 to 8570 ybp (3 samples). †Tinajas Altas, leaves, calyces, seeds, 1230 to 8700 ybp (6 samples).

Hedeoma

Annuals and herbaceous perennials. North and South America; 40 species.

Hedeoma nana (Torrey) Briquet subsp. **macrocalyx** W.S. Stewart
Dwarf false pennyroyal; *orégano*. Figure 15.

Perennial herbs 20–40 cm tall, the stems numerous and wiry; also flowering in the first season. Herbage highly aromatic. Leaves often 1–1.5 cm long, elliptic to ovate and acute, the lower surfaces usually purplish. Flowers small but showy, in short, clustered whorls at the upper stem nodes. Calyx unequally 5-toothed, conspicuously hairy, the calyx tube 3.5–4.5 mm long. Corollas 5–7+ mm long, bilabiate, lavender with darker spots and white ridges in the throat. Stamens 2. Flowering at least in spring.

Scattered localities in the larger mountains in Organ Pipe (Ajo, Diablo, Puerto Blanco mountains) and Childs Mountain in Cabeza Prieta; especially in rocky habitats, mostly along canyon bottoms and north-facing slopes and sometimes in large washes leading out of the Ajo Mountains. This or a similar pennyroyal grew in the Ajo Mountains 1200 to 13,500 years ago.

Subspecies *macrocalyx* in western, central, and southern Arizona and northern Sonora. Two other varieties, California, Nevada, and Utah to western Texas and northern Mexico to San Luis Potosí.

Figure 15. *Hedeoma nana*. Alamo Canyon: (A & C) 3 Sep 2014; (D) 17 Oct 2013. (B) Burro Creek, Yavapai Co., 29 Oct 2013, photo by Elizabeth Makings.

OP: Canyon Diablo, 21 Mar 1935, *Kearney 10852*. Alamo Canyon: 2500 ft, 11 Mar 1950, *Supernaugh 434*; 0.1 mi upstream from Alamo Well, *Wirt 27 Apr 2005*. Arch Canyon, 5 Apr 1978, *Bowers 1173*. Alamo Wash at Hwy 85, *Beale 28 Feb 1988* (ORPI). Large wash draining NE slopes of Pinkley Peak, 31 Oct 2003, *Rutman 2003-1031-17* (ORPI). Above Bull Pasture on trail to crestline, 3220 ft, 10 Apr 2005, *Felger 05-231*. †*H.* cf. *nana*: Alamo Canyon, fruits, 1150 & 9570 ybp. †Montezuma's Head, fruits, 13,500 ybp.

CP: Childs Mt, near summit in canyon bottom, mostly N and E sides of rocks, 5 Mar 1994, *Felger 94-11*. Growler Mts, vicinity of Growler Peak, just N of Charlie Bell Pass, 302721 E, 3587946 N, *Peter Holm 4 Apr 2014*.

Monardella

Annuals to shrubs. Western North America; 30 species.

Monardella arizonica Epling
Arizona monardella. Figure 16.

Herbaceous or sub-shrub perennials to 40 cm tall, aromatic, moderately to densely pubescent, and with rhizomes. Stems terete to 4-angled. Leaves mostly 0.5–2+ cm long, sessile, linear to elliptic or lanceolate, glandular punctate and with stalked glands. Flowers in head-like, stalked clusters subtended by green to purplish bracts to 1.5 cm long. Flowers sessile; corollas tubular, 1–1.5 cm long, white and spotted with violet, the upper lip 2-lobed, the lower lip 3-lobed. Stamens 4. Nutlets to 2 mm long. Flowering at least October and November.

Higher elevations in the Ajo Mountains; uncommon, growing from crevices in bedrock. It ranged across the flora area from at least 9000 to more than 37,000 years ago.

Western and southern Arizona, generally above the desert.

OP: Bench in Estes Canyon, *Henry 6 Nov 1977* (ORPI). Arch Canyon, 12 Oct 1988, *Baker 7640* (ORPI). †Alamo Canyon, leaves, involucres, fruits, 9570 ybp. †Puerto Blanco Mts, on ridge, leaves, fruits, 14,120 ybp.

TA: †Tinajas Altas, involucres, fruits, 8979 to 18,700 (9 samples), & >37,000 ybp.

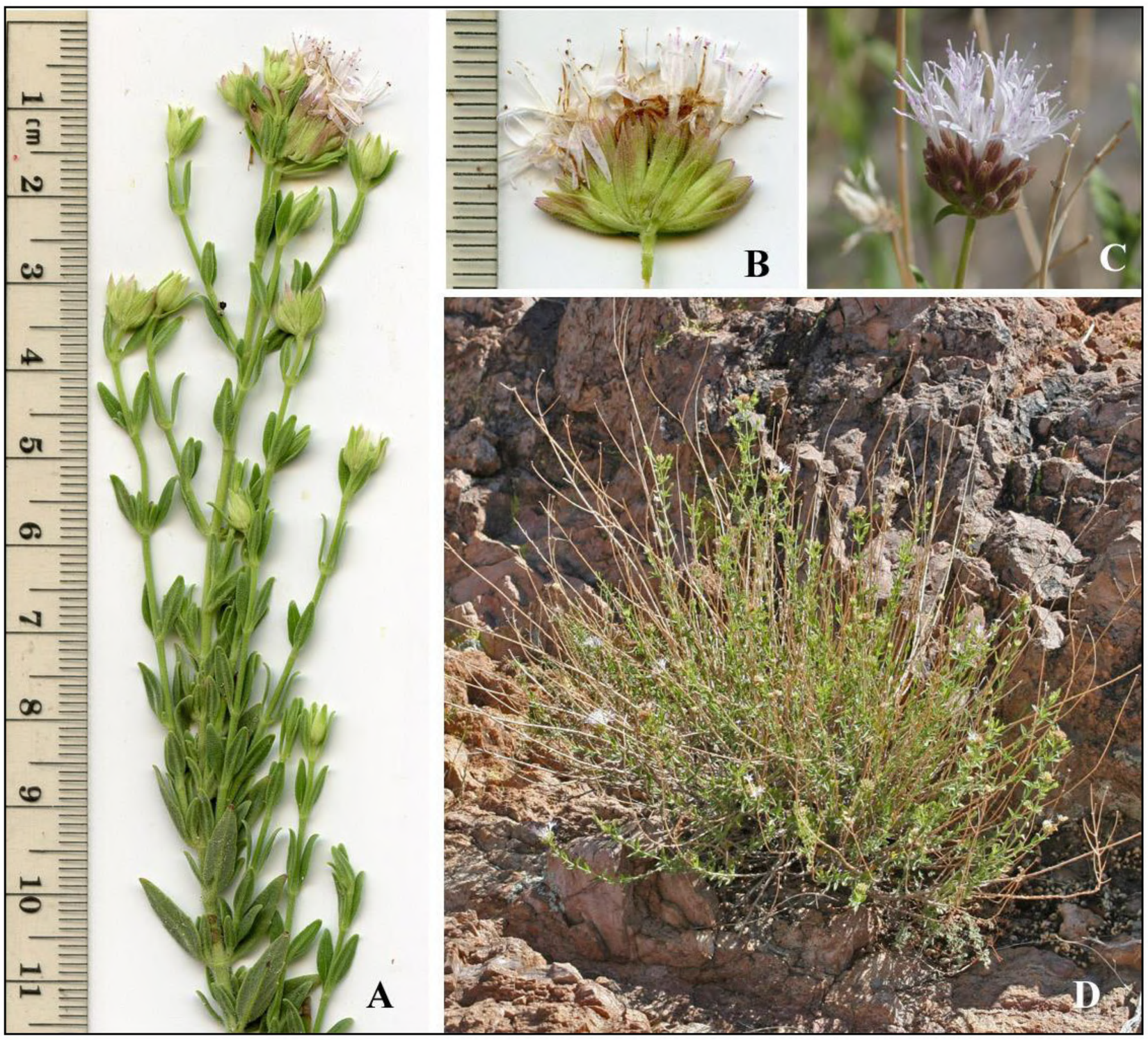

Figure 16. *Monardella arizonica*. (A & B) Bull Pasture Trail, Estes Canyon, 8 Sep 2014. (C & D) Boulder Canyon, 24 Sep 2007.

Salvia – Mint

Ephemerals, herbaceous perennials, and shrubs; mostly aromatic. Inflorescences of spikes, often interrupted (flower clusters separated by bare stem), the flowers in whorls (verticils), or in terminal head-like clusters. Corollas 2-lipped. Stamens 2, arching beneath the upper lip, often with an elongated connective (portion of filament connecting the anther sacs of a stamen), one of the anther sacs (pollen sacs) reduced. Worldwide; 900 species.

1. Winter-spring ephemerals.

    2. Leaves mostly in a basal rosette and prominently pinnatifid; widespread. ..... **Salvia columbariae**
    2. Leaves cauline (along the stems), not in a basal rosette, entire or shallowly toothed; rare..... **Salvia reflexa**

1. Robust herbaceous perennials, shrubs or subshrubs with leafy stems.

3. Inflorescences reaching 8 cm long; calyx not markedly glandular, the lobes blunt; corollas blue; Ajo Mountains..... **Salvia pinguifolia**
3. Inflorescences of spike-like panicles more than 20 cm long; calyx markedly glandular, the lobes spine-tipped; corollas white; mountains in Cabeza Prieta and the Goldwater Range ..... **Salvia vaseyi**

Salvia columbariae Bentham
Desert chia; *chía*; da:pk. Figure 17.

Winter-spring ephemerals, with mostly short, white hairs and sessile, golden to red-orange, globular glands especially dense on the lower leaf surfaces and calyces. Leaves mostly in basal rosettes, 4–9 (12) cm long, once or twice pinnatifid, the petioles prominent and narrowly winged, the stem leaves substantially reduced upward. Flowers in dense clusters (1.5) 2–4 cm wide, terminal and widely separated on leafless stems 5–35+ cm tall, the clusters appearing skewered on the flowering stems. Floral bracts nearly orbicular with spinescent tips. Calyx 9–12 mm long, the upper lip with a 2-pronged spinescent tip. Corollas dark blue. Nutlets ("seeds") smooth, flattened, about 2 mm long, mucilaginous when wet.

Widespread in Organ Pipe and Cabeza Prieta, mostly at lower elevations; washes, bajadas, sand flats, and dunes.

Arizona, California, Nevada, Utah, Baja California, and northwestern Sonora.

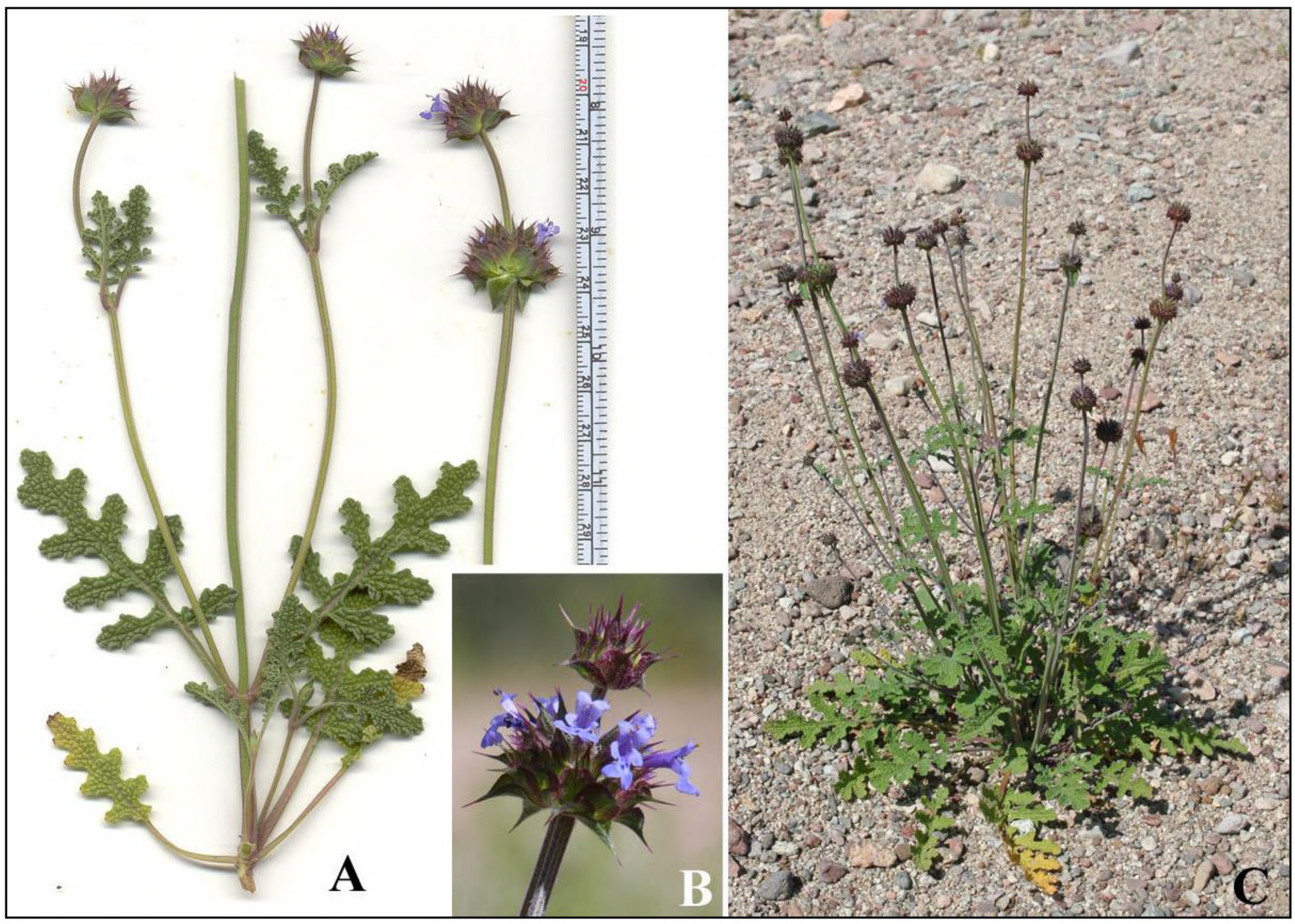

Figure 17. *Salvia columbariae*. (A) Estes Wash, 7 Mar 2008. (B) Chico Suni Wash near Chico Suni Village, 26 Feb 2005. (C) Headquarters Wash near Visitor Center, Organ Pipe, 15 Mar 2004.

The seeds were "much relished" by the Hia-Ced O'odham (Lumholtz 1912: 204) and by many others as a significant food resource in many regions of the Sonoran Desert (Felger 2007; Hodgson 2001). Placed in water, the seeds become gelatinous and were consumed as a beverage. The seeds were also parched and ground into flour, which was often stored. The seeds were also widely used medicinally, especially to treat eye irritants and ailments (Bean & Saubel 1972; Felger et al. 1992). Desert chia is sometimes cultivated.

OP: W of Bates Mts, 31 Mar 1978, *Bowers 1164*. Estes Canyon, 9 May 1979, *Bowers 1699*. Ajo Mountain Rd. (east loop), 6.5 mi NE of Hwy 85, 11 Mar 1983, *Daniel 2633* (ASU). Aguajita, 6 Apr 1988, *Felger_88-281*. Upstream from Bates Well, 1345 ft, 11 Mar 2003, *Felger 03-293*.
CP: Pinacate Lava flow (see Simmons 1966).

††Salvia mohavensis Greene
Mojave sage

Broad, compact small shrubs, with small glands and minute white hairs. Inflorescences of compact, head-like spikes with crowded bracts and blue flowers.

Widespread in the Sonoran Desert Region through the late Pleistocene, and part of the local flora from 9200 to more than 37,000 years ago. The nearest present-day occurrences are relictual populations at higher elevations in the Sierra Pinacate and the nearby Mohawk and Maricopa mountains. The present-day range is in the Mojave and Sonoran deserts in southeastern California, southern Nevada, western Arizona, and the Sierra Pinacate in Sonora.

OP: †Puerto Blanco Mts, on ridge, leaves, involucres, 10,540 & 14,120 ybp.
TA: †Butler Mts, twigs, leaves, 10,360 & 11,060 ybp. Tinajas Altas, leaf fragments, calyces, 9230 to 18,700, & > 37,000 ybp (12 samples).

Salvia pinguifolia (Fernald) Wooton & Standley
Rock sage. Figure 18.

Aromatic shrubs to about 1.5 m tall, the bark shredding. Stems slender and brittle. Herbage with minute unbranched hairs. Leaves petioled, the blades 2–5 cm long, mostly broadly triangular-ovate, often pale grayish green below, the margins toothed or scalloped. Inflorescences spike-like to 8 cm long. Flowers pedicelled. Calyx 7 mm long. Corollas blue, 12–15 mm long with a prominent lip; June to September.

Canyons and rocky slopes to the summit in the Ajo Mountains. It has been in the Ajo Mountains for 22,000 years and was in the Puerto Blanco Mountains 8000 years ago. It is no longer in the Puerto Blanco Mountains and no longer occurs at the Ajo Mountains midden site.

This salvia extends eastward and northward in southern and central Arizona to western Texas, and occurs in northern Sonora, northern Chihuahua, and Coahuila.

OP: Ajo Mts, *Nichol 3 Jun 1937*. W side of Alamo Canyon, 13 Sep 1941, *Goodding 299-41*. [Ajo Mts], base of ledges near summit, 28 Aug 1943, *Clark 10920* (ORPI). Canyon N of Alamo Canyon, 3500 ft, infrequent on rocky slope, 31 Mar 1948, *Darrow 3850*. Arch Canyon, shaded microsite below the arch, 2880 ft, 12 Sep 2013, *Rutman 20130912-20*. †Montezuma's Head, twigs, leaves, seeds, 14,500 & 21,840 ybp. †Puerto Blanco Mts, on ridge, fruits, 7970 ybp.

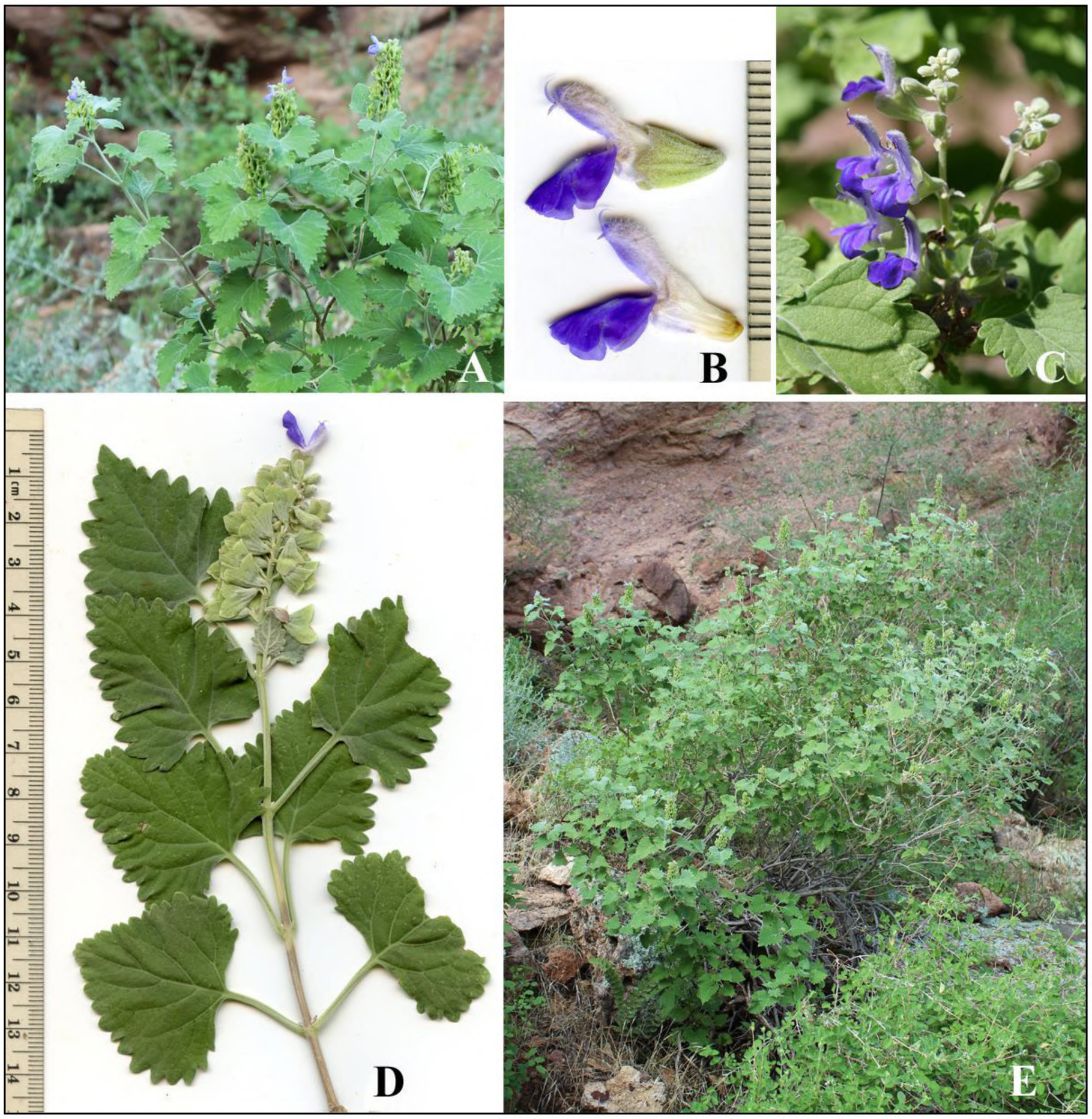

Figure 18. *Salvia pinguifolia*. (A, B, D & E) Bull Pasture Trail, Estes Canyon, 8 Sep 2014. (C) Arch Canyon, 16 Sep 2006.

****Salvia reflexa** Hornemann
Lance-leaf sage

Aromatic, rather delicate ephemerals; stems slender, 15+ cm in height. Stems leafy; leaves often 2–3 cm long, elliptic-oblong to narrowly lanceolate, the margins entire or shallowly toothed. Flowers mostly in pairs at distal nodes. Corollas about 1 cm long, pale whitish blue to blue, the Organ Pipe specimen recorded as having white corollas.

Known in the flora area from a single record at the Organ Pipe "campground" (near the park headquarters). Perhaps it was accidently introduced by a visitor, as with *Thlaspi arvense* (Brassicaceae) also known from a single collection at the same place and on the same date by Don Pinkava and associates. The nearest known records for this mint are in eastern and central Arizona.

This small mint is widespread in non-desert regions of North America and is often weedy.

OP: Campground, *Larrea* desert, flowers white, 25 Nov 1972, *Pinkava 9994* (ASU, det. D. Peppin, 26 Oct 2008).

Salvia vaseyi (Porter) Parish
[*Audibertia vaseyi* Porter]
Scallop-leaf sage. Figure 19.

Highly aromatic shrubs or sub-shrub perennials reaching 1+ m tall; facultatively drought deciduous and experiencing severe dieback in drought. Leaves mostly 2–9 cm long, petioled, and highly variable in size depending on soil moisture. Leaf blades mostly elliptic to ovate or oblong-ovate, pale green to whitish green; the margins scalloped with short, blunt teeth. The leaf blades are notably thick and the surfaces rugulose with prominently raised veins. Furthermore, the surfaces are covered by a dense tomentum of minute appressed hairs that impart a glaucous appearance (but not glaucous); these hairs often obscure the rugulose surfaces, filling the "valleys" between the raised veins (Walter Fertig, pers. comm. to Felger, 18 Jun 2015).

Inflorescences verticillate on tall, wand-like flowering stems; flowers in dense clusters or whorls at widely spaced intervals on the stem. Calyces 8–14 mm long, densely glandular, the lobes mostly awned, the awns becoming spinescent when dry at seed maturity. Corollas, filaments, and styles pure white. Corolla tube 13–20 mm long. Stamens and styles exerted. Fruits with light brown nutlets 2.5–3 mm long. Flowering spring and fall, depending on rains.

This unique mint was found in three local areas in the Sierra Pinta, each approximately 60 m in diameter and on steep granitic slopes with southwest exposures (Cain et al. 2010). The plants at the summit, at 816 m (2670 ft; *Cain & Jansen 21 Feb 2003*), were common but not abundant. The second site, on the lower slope of the mountain at 6 km north of the first locality, had 20–30 plants. The third site, near the base of the mountain at 405 m (1330 ft; *Cain & Jansen 21 Apr 2005*; Figure 19) and 5 km northwest of the first site, had fewer than 12 individual plants. On 8 March 2010, Jim Malusa found a population in the Copper Mountains on a north-facing slope about 120 m below the summit. The plants were common at this site. The Copper Mountains are about 28 km west-northwest of the Sierra Pinta.

Salvia vaseyi was previously known only from the west side of the Sonoran Desert in southern California and Baja California mountains near the California border. No morphological differences were found between Arizona and California specimens.

During extensive fieldwork over several years, Cain and Jansen did not find other *Salvia vaseyi* plants in the Sierra Pinta or to the west in the ecologically similar Cabeza Prieta Mountains, and Malusa reported that he did not find additional plants in the Copper Mountains or nearby similar mountains. Felger and others have conducted extensive fieldwork in other granitic mountains in southwestern Arizona and also have not found other *S. vaseyi* plants. Yet, due to the remote location of many southwestern Arizona mountains and restricted vehicle access in designated wilderness areas, there might be other localities where this or other previously undocumented species occur. *Salvia vaseyi* in Arizona seems to represent a relict population, most likely from a more extensive Ice Age distribution contiguous with the Californian populations. Similar Ice Age relict populations on either side of the Salton Trough are commonplace (e.g., Van Devender 1990, 2007, and Deep History in the Introduction to this flora series, Felger et al. 2013a).

There are five shrubby species of *Salvia* in Arizona: *S. dorrii* (Kellogg) Abrams complex (includes *S. pachyphylla* Epling ex Munz), *S. mohavensis*, *S. parryi* A. Gray, *S. pinguifolia*, and *S.*

vaseyi. Among these, *S. vaseyi* is most xeric-inhabiting species, has the narrowest ecological and geographic range, and can be distinguished by rugulose leaf blades with crenulate (scalloped) margins, bristle-tipped calyx teeth, and pure white flowers.

Figure 19. *Salvia vaseyi*. Sierra Pinta, ca. 2.7 mi NNW of Sunday Pass, 1330 ft, Yuma Co., 21 Apr 2005, photos by James W. Cain III.

CP: Top of Sierra Pinta, 0.5 mi S of Sunday Pass, 32.295100°N, 113.560510°W (WGS 84), 816 m (2670 ft), 12–18 inches tall, locally common among granite boulders, *Cain & Jansen 11 Feb 2003*. Sierra Pinta, 2.7 mi WNW of Sunday Pass, just S of Isla Pinta, 32.33719°N, 113. 59921°W (WGS 84), 405 m (1330 ft), *Cain 21 Apr 2005* (ARIZ, ASU, DES).

Barry M. Goldwater Range: Copper Mountains, ¼ mi E of summit, UTM E 218700, N 3599669 (WGS 84), 2480 ft, *Malusa 8 Mar 2010*.

Scutellaria – Skullcap

Perennial herbs and shrubs. Worldwide, mostly temperate; 360 species.

Scutellaria mexicana (Torrey) A.J. Paton
[*Salazaria mexicana* Torrey]
Bladder-sage. Figure 20.

Mound-like shrubs, reaching 1–1.5 m tall, the stems interlacing and branching at right angles. Twigs slender and brittle, often spinescent-tipped, with sparse foliage; pubescent with short, rather thick, and mostly appressed white hairs. Leaves quickly drought deciduous, sessile or short-petioled, the larger leaves 1–1.8+ cm long, lanceolate to ovate or elliptic; margins entire. Inflorescences racemose. Flowering calyx often dark rose, about half as long as the flower, the fruiting calyx enlarging to become globose and inflated like a balloon or paper bag, 15–20 mm long. Corollas 16–22 mm long, 2-lipped, lobes of upper lip dark blue, the lower lip white with purple-blue nectar guides. Stamens 4. Massive flowering at various seasons following rains.

Figure 20. *Scutellaria mexicana*. (A & D) Joshua Tree National Park, 30 Apr 2012. (B & C) Tinajas Altas, 2 Mar 2014, photos by Sue Carnahan.

Cabeza Prieta and Tinajas Altas on steep rocky slopes, especially north-facing exposures at higher elevations, canyons, and upper bajadas; and one record from Organ Pipe near the top of Bates Mountain.

Deserts in western Arizona, southeastern California, southwestern Utah, both states of Baja California, and northwestern Sonora, and disjunct in Texas, Chihuahua, and Coahuila.

Molecular data indicates *Salazaria* should be included with *Scutellaria* (Paton 1990; Wagstaff et al. 1998). Morphologically, however, *Salazaria* is distinctive in being a woody-based shrub rather than herbaceous, having reduced leaves, green (cladophyllous) and somewhat thorny stems, resupinate ("upside down") flowers, and an unusual inflated calyx enveloping the fruit. Otherwise the flower structure, anthers, and fruits are similar to those of *Scutellaria* (James Henrickson, pers. comm. to Felger, 2010).

OP: Saddle just N of Kino Peak, *Wilson 9 Apr 1993* (ORPI).

CP: Heart Tank, *Simmons 16 Mar 1963* (CAB). N side of Tule Mts, 2 Feb 1992, *Felger 92-51*. Salazaria Wash, 12 Apr 1992, *Harlan 250* (CAB). Canyon at Agua Dulce Tank, 13 Jun 1992, *Felger* (observation). Growler Mts, vicinity of Growler Peak, just N of Charlie Bell Pass, 302813 E, 3588012 N, *Peter Holm 4 Apr 2014*.

TA: Tinajas Altas, canyon bottom, 1000 ft, 28 Oct 1937, *Gentry 3524*. Tinajas Altas Mts, Camino del Diablo, canyon bottom in upper canyon, 0.4 km SW from the uppermost of tinaja, 26 Nov 2004, *Felger 04-90*.

Tetraclea

Perennial herbs, 2 species; southwest U.S. and Mexico.

Although *Tetraclea* has been treated as part of *Clerodendrum*, that genus in the broad sense is polyphyletic, leading to restored recognition of *Tetraclea* (Yuan et al. 2010). *Clerodendrum* sensu lato with 150 species is worldwide in temperate to mostly tropical regions; following Yuan et al. (2010) a monophyletic *Clerodendrum* is restricted to the Old World.

Tetraclea coulteri A. Gray
[*Clerodendrum coulteri* (A. Gray) Govaerts]
Coulter's wrinkle-fruit. Figure 21.

Foul-smelling, herbaceous perennials, rhizomatous and often forming clonal colonies. Plants with small, recurved, white hairs. Stems 4-angled, slender, leafy, and upright, to 40 cm long. Leaves 1.5–3.5 (5.5) cm long; petioles winged, 4–10 mm long; leaf blades mostly ovate to lanceolate-ovate, tending to be entire on lower (larger) leaves and coarsely toothed on upper leaves. Inflorescences of 1–4-flowered axillary clusters sometimes nearly throughout the plant. Calyx deeply 5-parted, enlarging in fruit. Corollas with a pinkish tube and 4 or 5 broad, white lobes. Stamens 4, long exserted. Style about as long as the stamens and 2-branched at the tip. Fruits of 4 nutlets (or 2 by abortion). Growing with hot weather and flowering at least after summer-fall rains.

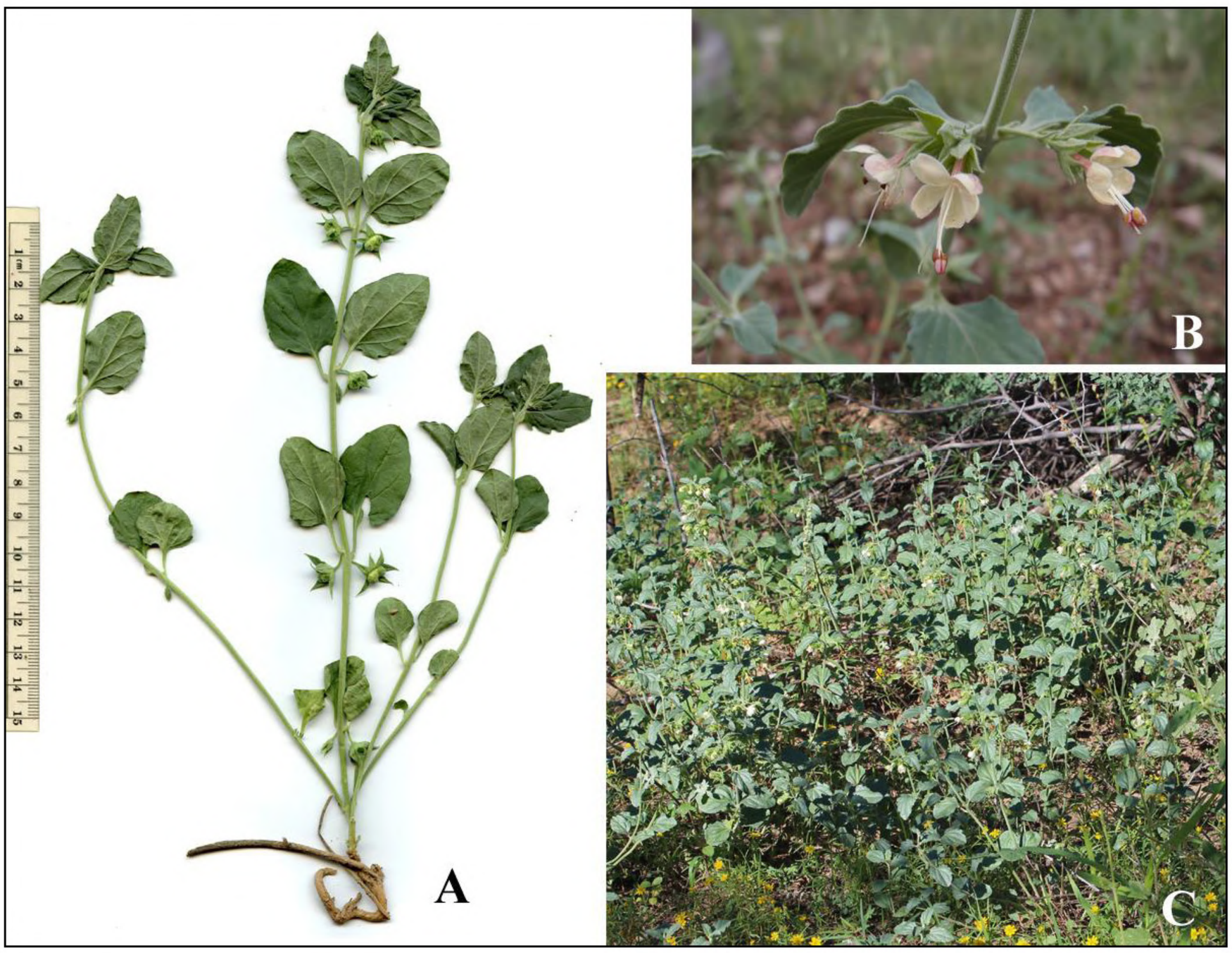

Figure 21. *Tetraclea coulteri*. (A) Midway Tank, between Ajo and Why, 31 Aug 2014. (B) Salero Ranch, Santa Cruz Co., 14 Aug 2011, photo by Sue Carnahan. (C) Small drainage near the Bates Well Road, N of Bates Mts, 4 Aug 2014.

Widely scattered and apparently highly localized in low elevation areas of Organ Pipe and the east side of Cabeza Prieta; mostly in areas where water settles on sandy and loamy soils, especially in shaded or partial shaded niches. Sometimes also in rocky areas, such as the Diablo Mountains near Ajo Mountain Drive and along the Bates Well Road, but growing in deposits of fine soils along drainages. *Tetraclea coulteri* and *Phacelia pedicellata* are the stinkiest plants in the flora area.

Southern Arizona to western Texas and the Chihuahuan Desert Region to Puebla, and a few localities in northern Sonora including a 1941 record west of Hermosillo (*Wiggins & Rollins 179*).

OP: 2 mi SE of Walls Well, near N end of Ajo Mts, banks of broad sandy wash, 30 Aug 1945 *Haskell 3219*. 1.5 mi E of Blankenship Ranch, *Rutman 24 Nov 1997* (ORPI). Near Pozo Nuevo–Bates Well Road junction, *Rutman 23 Aug 2001* (ORPI). 3 mi E of Dos Lomitas along border road, *Rutman 29 Aug 2001* (ORPI). Valley of the Ajo, xeroriparian, sandy-loam soil, *Wirt 9 Sep 2003*. Cuerda de Leña Wash, 0.5 mi S of Organ Pipe north boundary, rare, shaded loamy bank above scour line, 7 Oct 2006, *Rutman 20061007-16*.

CP: Camino del Diablo 2.4 mi SW of E Refuge boundary, roadside in sand soil, 15 Sep 1992, *Felger 92-741*. San Cristobal Wash at Camino del Diablo, 26 Sep 2013, *Rutman 20130926-10*.

Teucrium

Ephemerals or perennial herbs with square stems. Corollas seemingly with only a lower lip, the middle lobe enlarged and often elongated, the pair of smaller lateral lobes derived from part of the upper lip. Stamens 4. Worldwide; 250 species.

1. Ephemerals, pubescent at least on upper part of plant; corollas to 11 mm long, blue to nearly white..... **Teucrium cubense**
1. Perennials, essentially glabrous except for pedicels and a few hairs on newest growth and corollas; corollas more than 15 mm long, white or whitish and often with lavender nectar guides. ..... **Teucrium glandulosum**

Teucrium cubense Jacquin subsp. **depressum** (Small) E.M. McClintock & Epling
Dwarf germander. Figure 22.

Non-seasonal ephemerals, the stems 8–45 cm long, soon spreading to ascending-decumbent. Herbage and inflorescences glandular, the inflorescences and sometimes the new herbage with coarse, white, curly to crinkled hairs. Leaves 3–8 cm long, variously lobed or incised; lower leaves broader and not as deeply cut as upper leaves, the upper leaves with fewer but larger lobes. Flowers in leafy-bracted terminal racemes. Pedicels (0.8) 2–8 mm long. Calyx 4.5–6.5 (7) mm long, deeply parted into prominent teeth. Corollas pale blue to nearly white, 8–11 mm long. Nutlets 2.2–2.5 mm long, somewhat obovoid, glandular, with short bristly hairs on reticulate ridges.

Localized in fine-textured soils in low lying, seasonally wet and often poorly drained habitats including swales in mesquite floodplains, areas of overland flood flow, playas, wet to damp mud at the margins of dirt tanks (charcos), roadside depressions, and sometimes in canyon bottoms; often locally abundant.

Southeastern California to western Texas, and northwestern and north-central Mexico. This species, with 5 subspecies, extends to southeastern USA, the Caribbean, and southern South America.

OP: Alamo Canyon, 2 Apr 1944, *Clark 11669* (UNM). Dos Lomitas, *Wirt 12 Apr 1989*. Impoundment of earthen embankment, Hwy 85 at 0.7 mi S of N boundary of Monument, *Rutman 2 Apr 1998* (ORPI). Kuakatch Wash near village of Kuakatch, just W of E boundary of Organ Pipe, shaded bank of wash, 24 Mar 2013, *Rutman 20130324-1*.

CP: Jose Juan Tank, 26 Feb 1993, *Felger 93-99*. Agua Dulce Mts, 1075 ft, *Schmidt 7 Jan 1997*. San Cristobal Wash, N boundary of Refuge, *Malusa 18 Apr 2001*. Las Playas, 28 Nov 2001, *Felger 01-570*.

Figure 22. *Teucrium cubense* subsp. *depressum*. Pinacate Junction, Pinacate Biosphere Reserve, Sonora: (A) 8 Feb 2015; (D) 28 Mar 2013. (B & C) Wildlife charco E of Hwy 85 near mile 58, 7 Feb 2014.

Teucrium glandulosum Kellogg

Desert germander. Figure 23.

Herbaceous perennials, somewhat bushy and sometimes dying back severely in drought, commonly 40–75 cm tall including inflorescences. Stems slender and brittle, mostly erect from a much-branched caudex. Leaves and calyx surfaces glandular-punctate with glistening golden glands. Leaves gradually drought deciduous, (1.6) 2.3–6 cm long, sessile, mostly lanceolate; lower leaves sometimes with 1–3 prominent teeth on each side, the larger leaves with a pair of large lobes; upper stem leaves reduced and usually entire. Flowers relatively large and attractive, in racemes (13) 18–50 cm long. Youngest herbage, buds, and corollas with a few scattered hairs. Pedicels (7) 9–27 mm long, longest in the lower part of the inflorescences, glandular and also with short white hairs. Calyx 5–8 mm long, deeply parted into prominent teeth. Corollas 18–26 mm long, white with pale purple nectar guides, or sometimes all white. Nutlets 3–3.4 mm long, oval, glandular, and hairy at the tip. Flowering at least spring and fall.

Shaded canyon bottoms in at least several mountain ranges in Cabeza Prieta, one record in Organ Pipe, and Coyote Wash in the Tinajas Altas Region, but probably more widespread.

In the USA known otherwise only from the Castle Dome Mountains in western Arizona and a few locations in California. Also northwestern Sonora and both Baja California states. This is one of the few species in this large genus confined to a desert.

OP: High-angle bedrock drainage to the NW of Kino Peak, 2000 ft, under dry waterfall and protected from scour, single plant seen, 31 Mar 2005, *Rutman 20050320-39*.

CP: Cabeza Prieta Tanks, *Simmons 26 Oct 1962*. Eagle Tank, 13 Jun 1992, *Felger 92-586*. Heart Tank, 27 Feb 1993, *Felger 93-156*. Buck Peak, 1700 ft, *Jansen 24 May 2005*.

TA: Coyote Wash at Camino del Diablo, clay-like soil in dense mesquite brush, 10 Jan 2002, *Felger 02-14*.

Figure 23. *Teucrium glandulosum*. (A) SW Copper Mountains, 2.1 km S of Coyote Peak, Yuma Co., 22 Oct 1993, *Schulz 402* (ASU, SEINet). (B) Photo by David Sussman (SEINet).

LINACEAE – Flax Family

Annual and perennial herbs, vines, trees, and shrub. Worldwide; 12 genera, 300 species.

Linum

Mostly Eurasia and North America; 180 species.

***Linum bienne** Miller

Pale flax. Figure 24.

Spring ephemerals (elsewhere perennial herbs) with upright stems to about 50 cm tall; glabrous. Leaves alternate, held upright close to the stem, sessile, about 1–2 cm long, linear to narrowly lanceolate, the margins entire. Flowers 5-merous and radially symmetric, on slender

pedicels. Corollas pale blue; petals 5, each 10–15 mm long, broadly obovate. Fruits of broadly ovate capsules, 5–7 mm long, seeds gelatinous when wet. Flowering March and April.

Figure 24. *Linum bienne*. (A & B) Hwy 85 near mile marker 70, 26 Feb 2005. (C) Deer Creek Center, Selma, Josephine Co., OR, 17 May 2007, photo © by Keir Morse (CalPhotos).

Occasional and widely scattered in Organ Pipe, but not in the southern margin and southwestern portion of the Monument; bajadas, rocky slopes, arroyos, and roadsides.

Native to the Mediterranean region and western Europe; naturalized in western North America and elsewhere. *Linum bienne* is the probable ancestor of the cultivated flax, *L. usitatissimum*. *Linum bienne* is locally common in some areas in southern Arizona. It is often confused with the native *L. lewisii* Pursh. They can be distinguished as follows:

1. Plants upright; margins of inner sepals minutely ciliate or toothed; corollas pale blue; stigmas linear to club-shaped..... **Linum bienne**
1. Plants slightly spreading; margins of inner sepals entire; corollas blue (not pale); stigmas rounded..... **Linum lewisii**

OP: Near Cherioni Well, *McDougall 9 Apr 1941*. Wash, *Waldon 18 Apr 1964* (ASU). N of headquarters, bajada, *Ranzoni 26 Mar 1965* (ORPI). Puerto Blanco Drive, *Beale 2 Mar 1986* (ORPI).

LOASACEAE – Stickleaf Family

Ephemerals, herbaceous perennials, and shrubs. Hairs silicified or calcified, barbed (usually glochidiate—barbs in whorls), needle-like, or gland-tipped. Leaves alternate (those in the flora area) and simple; stipules none. Flowers radial. Sepals 5, persistent; petals separate or united, 5 (or

seemingly 10 including staminodes). Stamens 5 to many, the filaments narrow or petal-like in the outermost whorls. Ovary inferior, the style 1. Fruits dry, dehiscent and multiple-seeded or indehiscent and 1-seeded.

Mostly in the Americas; 14 genera, 265 species.

1. Perennials; flowers white; stamens 5; fruits 1-seeded and indehiscent..... **Petalonyx**
1. Ephemerals (short-lived perennials in *Mentzelia puberula*); flowers green, yellow, orange, or whitish; stamens 10 or more; fruits many-seeded.

2. Stems and petioles thickened and succulent or semi-succulent; leaf blades as wide as or wider than long, the upper surface glistening; corollas tubular, yellowish with green lobes..... **Eucnide**
2. Stems and petioles not succulent; leaf blades mostly longer than wide, the surfaces dull; corollas whitish, yellow, or orange, not tubular..... **Mentzelia**

Eucnide

Annuals (or subshrubs elsewhere). Southwestern USA to Guatemala; 14 species. The three species of the genus *Sympetaleia* were placed in *Eucnide* section *Sympetaleia* by Thompson and Ernst (1967). These three species are ephemerals/annuals confined to the Sonoran Desert Region surrounding the Gulf of California. Unlike other *Eucnide*, the three *Sympetaleia* do not having stinging hairs (e.g., Wiggins 1964).

Eucnide rupestris (Baillon) H.J. Thompson & W.R. Ernst
[*Sympetaleia rupestris* (Baillon) A. Gray ex S. Watson]
Velcro plant, rock nettle. Figure 25.

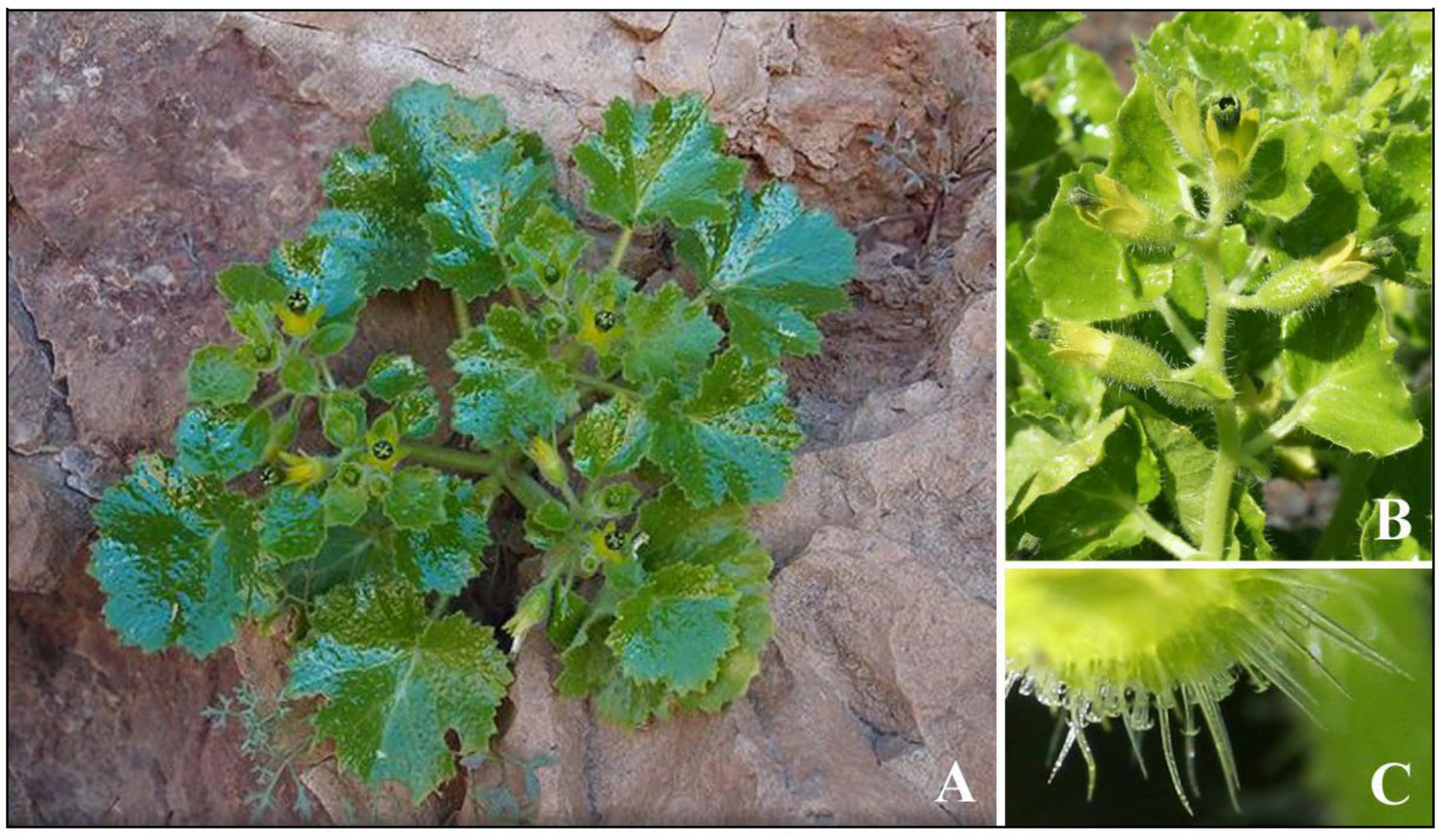

Figure 25. *Eucnide rupestris*. (A) Bahía San Pedro, Sonora, 5 Feb 2015, photo by Sue Carnahan. Lava flow and cinders near Red Cone trailhead, Pinacate Biosphere Reserve, 3 Mar 2009: (B) Flowering branch; (C) Portion of margin of a calyx lobe.

Non-seasonal ephemerals, the roots unusually small relative to plant size. Herbage, inflorescences, ovaries, and calyx bases with stout, glassy hairs, the larger hairs smooth and needle-like, the shorter hairs with a terminal whorl of barbs like miniature grappling hooks, causing pieces of the plant to stick like Velcro. Leaf blades 3–7 cm wide, nearly rounded or cordate at the base, broadly toothed to shallowly lobed, relatively thin and bright yellow-green, the upper surfaces glistening. Flowers about 1.5–2 cm long; calyx lobes yellow; corollas dull yellow and tubular below, the lobes short, bright green, and scarcely or not spreading. Fruits opening terminally by valves. Seeds minute, numerous.

Locally common in the vicinity of Cabeza Prieta Tanks where it grows on crevices of canyon cliffs, and along sandy-gravelly washes. Three additional records known from the flora area, although we expect it to occur in other scattered localities.

In the USA known otherwise only from southeastern California where it is rare. Common in northwestern Mexico near the USA border southward to northwestern Sinaloa, Baja California and Baja California Sur, and Gulf of California islands.

OP: Rancho Bonito, La Abra Valley, 9 Dec 1939, *Harbison 26214* (RSA, SD). Bates Mts, Kino Peak along trail at large NNE-facing cliff below peak, 2900 ft, *Wirt 5 Dec 1990.*

CP: Cabeza Prieta Tanks, 4 Feb 1959, *Monson 1*. Growler Mts, vicinity of Growler Peak, just N of Charlie Bell Pass, 302650 E, 3587997 N, *Peter Holm 4 Apr 2014.*

Mentzelia – Stickleaf, blazing star; *pegapega*

Spring or summer ephemerals or longer-lived annuals, or short-lived perennials (herbaceous perennials to shrubs elsewhere and one tree in the tropics). Stems often with peeling, whitish epidermis. Hairs barbed (glochidiate), the plants adhesive, especially the leaves and capsules (fresh leaf pieces stick on clothing like Velcro). For many or most mentzelias there is a transition from basal-rosette leaves to the bracts on the upper stems: leaves all sessile, or basal-rosette leaves and sometimes a few of the lower stem leaves are petioled, whereas upwards there is a gradation to smaller, sessile, and even clasping leaves or bracts. Flowers solitary and axillary or in terminal cymes usually with bracts. Petals 5 (or seemingly 10 including staminodes), deciduous, yellow or orange to whitish. Stamens 10 to many, the filaments slender, or outer stamens sometimes with broad, petal-like (petaloid) filaments or forming petaloid staminodes. Fruits of capsules, opening by 3 valves at the tip. Seeds few to many, variously sculptured, angled, prismatic, flattened, and/or winged.

Western North America to South America including the Atacama Desert; 120 species.

Sonoran Desert mentzelias can be grouped into four easily recognized sections and several species groups (see key to the species; Christy 1998). The flowers are usually closed during midday. Among the members of sections *Mentzelia* and *Trachyphytum* the flowers open in the morning, in section *Bartonia* the flowers open in the late afternoon, and in section *Bicuspidaria* the flowers are open in both morning and afternoon.

Among the members of section *Mentzelia,* and probably section *Trachyphytum,* some are obligately selfing (autogamous) and others are not, but in the flora area they are probably at least facultatively selfing. As might be expected, the smaller-flowered taxa with higher ploidy levels are self-compatible but not obligately selfing.

1. Stems including the main shoot notably slender; petals usually less than 8 mm long; flowers and capsules sessile; capsules narrowly cylindrical, sometimes gradually and slightly expanded above, and more than 5 times longer than wide.

2. Stems conspicuously pubescent and rough to the touch (scabrous-hispid); leaves petioled, lower leaves usually hastately lobed (large-lobed at the base); seeds clearly longer than wide. ..... sect. **Mentzelia**: **M. isolata**
2. Stems minutely pubescent (may appear glabrous without magnification) and smooth to the touch; stem (cauline) leaves sessile, lobed but not hastate; seeds about as wide as long. ..... sect. **Trachyphytum**

3. Capsules linear, straight (not curved) and not narrowed at the base; seeds in a single row in capsules, all precisely prismatic (3-sided prisms) and sharply angled, conspicuously and regularly grooved along the 3 longitudinal edges, the ends truncate (flat, as if sliced in cross-section), the surfaces smooth. ..... **Mentzelia affinis**
3. Capsules linear but slightly narrowed towards the base and often curved; seeds in 2 or more rows towards the apex (1 row at base), angular or not, at least those toward apex (tip) of fruit not precisely prismatic, not grooved on all 3 sides or if grooved on all 3 sides then the 3 "corners" not all the same shape (caution: seeds at base of capsules sometimes prismatic as in *M. affinis*)..... **Mentzelia desertorum**

1. Stems of main shoot not especially slender; petals usually more than 8 mm long; flowers and capsules pedicelled; capsules to about 2 times longer than wide, not narrowly cylindrical.

4. Bracts 1.5–3 cm long, ovate to elliptic, with white area at base, the margins with slender lobes; petals silvery; seeds not winged..... sect. **Bicuspidaria**: **Mentzelia involucrata**
4. Bracts less than 1.3 cm long, linear to linear-triangular, all green and entire; petals and petal-like filaments bright yellow; seeds winged..... sect. **Bartonia**

5. Caudex often thickened but lower stems not woody; larger leaves (5.5) 9–15 cm long, in a basal rosette; petals seemingly 10; seeds 3.3–4 mm long..... **Mentzelia longiloba**
5. Lower stems often woody like a dwarf shrub; larger leaves (1.8) 2.5–6.5 cm long, on the stems (cauline; the basal rosette very quickly withering in first season); petals 5 (the larger staminodes petal-like but clearly narrower than the petals); seeds 2.4–3.1 mm long. ..... **Mentzelia puberula**

Mentzelia affinis Greene
Triangle-seed blazing star; *pegapega*. Figure 26.

Spring ephemerals. Stems very slender, at first minutely pubescent (visible at 10× magnification), becoming glabrate and shiny white with age. Leaves sessile, highly variable, the lower leaves more or less narrowly elliptic to lanceolate, deeply and irregularly lobed, the upper leaves few-toothed to entire and sometimes broadly ovate. Bracts green throughout, variable, ovate to lanceolate, entire to lobed, shorter than the capsules. Flowers opening in the early morning, closing later the same morning, and apparently opening again the next day. Petals 5, small and bright yellow. Filaments all slender. Capsules sessile, slender and triangular in cross-section, not narrowed at the base, straight or curved, 11–15 × 1.5 mm. Seeds 0.9–1.3 mm wide, about as wide as long, in a single row in the capsule, angular, prismatic, conspicuously 3-angled and grooved along each angle, the ends abruptly truncate (flat and smooth as if sliced in cross sections); mottled and smooth in appearance with flat-topped papillae.

Widespread across the flora area, mostly on sandy soils in washes and flats.

Southern, central, and northwestern Arizona, northern Sonora, Baja California, southern California, and Nevada.

OP: Alamo Canyon, *Nichol 14 Mar 1939*. NW corner of Monument, 21 Mar 1941, *McDougall 6*. W of Bates Mts, 31 Mar 1978, *Bowers 1170*. Aguajita, 6 Apr 1988, *Felger 88-287*.

CP: 4.7 mi NE of Tule Well, 28 Mar 1985, *McLaughlin 2976*. 1.7 mi E of W Refuge boundary on Camino del Diablo, 16 Jun 1992, *Felger 92-620*. E Pinta Sands, 11 Apr 1993, *Felger 93-429*.

Figure 26. *Mentzelia affinis*. Mohawk Dunes, Yuma Co., 3 Mar 2014, photos by Sue Carnahan.

Mentzelia affinis and *M. desertorum*, members of section *Trachyphytum*, have slender stems throughout, small yellow or orange flowers, no petaloid staminodes, and narrow capsules. The petals tend to elongate with age, so that petal shape on the first day may be ovate but become lanceolate with age. Petal size may be of taxonomic significance, but is usually not discernable on herbarium specimens. Seeds at the base of the capsule tend to be triangular prisms with a longitudinal groove along each angle. The capsule is so narrow at its base that seed shape is largely the result of the developing seed(s) being confined between the walls of the triangular capsules. The grooves along the seed angles are formed by the placenta pressing against the seeds while they are still plastic and developing. In *M. affinis,* with its very slender capsules and seeds in a single row (like a stack of coins), all the seeds are triangular prisms. In M. *desertorum* only the lowermost seeds are triangular prisms (or at least a somewhat different shape than the upper seeds). For this reason it is important to look at seeds toward the apex of the capsule; unfortunately these seeds tend to fall out of mature capsules. Immature seeds are often more or less the same shape as mature seeds, but the surface sculpturing is not yet developed. When soaked in water the seeds swell to become spherical.

Mentzelia desertorum (Davidson) H.J. Thompson & J.E. Roberts
Figure 27.

Spring ephemerals. Stems whitish, slender, minutely pubescent, with age whiter and glabrate. Leaves sessile, highly variable, to about 12 cm long, linear to narrowly elliptic or lanceolate, margins variously lobed or toothed; first leaves in a basal rosette, stem leaves reduced above. Floral bracts lanceolate to broadly ovate to narrowly or broadly triangular, uniformly green, entire to few-toothed. Flowers sessile, opening in the early morning, closing later in the same morning, and apparently opening again the next day. Petals often 3–5 mm long, bright yellow, sometimes with a dark orange or reddish spot at the base. Stamens many, filaments slender, staminodes none. Capsules mostly 15–30 × 1.3–2 mm, sessile, cylindrical-triangular, gradually and slightly wider at the tip, curved downward 90° or more at maturity, especially those in stem axils. Seeds 0.8–1.2 mm in width and length, not winged, in 2 or more rows toward the capsule apex, variously concave or convex, the edges (angles) rounded, the seed surfaces flat, with a few dark papillae.

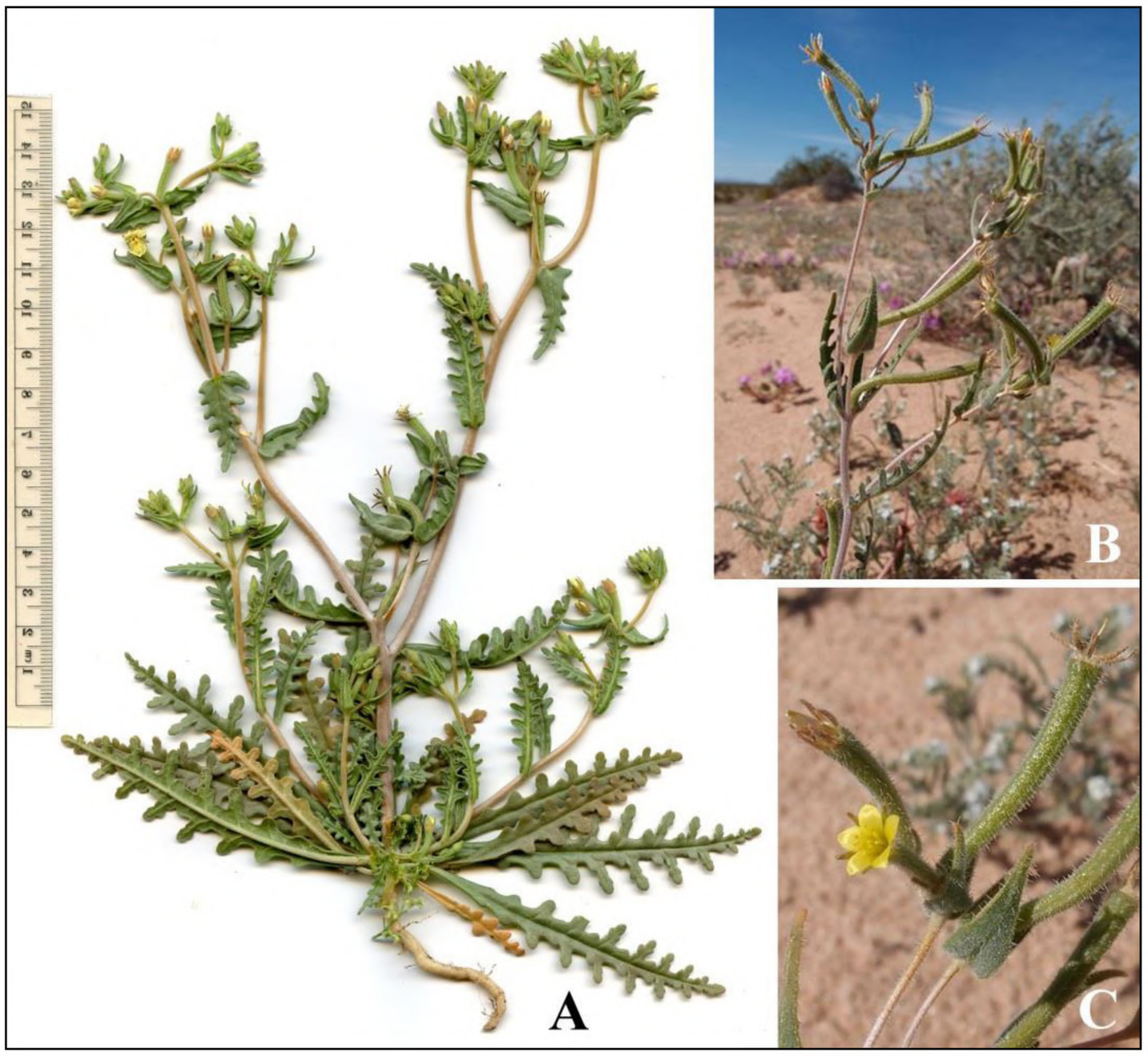

Figure 27. *Mentzelia desertorum*. (A) Midway Wash at Hwy 85, 8 Mar 2015. (B & C) Mohawk Dunes, Yuma Co., 3 Mar 2014, photos by Sue Carnahan.

Western part of Cabeza Prieta on sandy soils of washes and desert flats, and especially common on sand flats and dunes of the Pinacate lava area, Pinta Sands, and the nearby Gran Desierto in Sonora.

Mentzelia desertorum occurs in the core area of the Sonoran Desert: southeastern California, western Arizona, northeastern Baja California, and northwestern Sonora. *Mentzelia desertorum* and *M. albicaulis* are similar appearing plants with allopatric distributions; *M. albicaulis* does not occur in the core area of the Sonoran Desert. Brokaw and Hufford (2010) found *M. desertorum* to be distantly related to *M. albicaulis*.

CP: Papago Well, *Crooks 31 Mar 1937* (ARIZ 83230, det. Charlotte M. Christy 1995). Papago Wells [sic], sand dunes, *Crooks 31 Mar 1937* (ARIZ 83231, det. C.M. Christy 1995). W end of Pinacate Lava flow, 800 ft, uncommon on sandy flats, *Larrea*, *Hilaria*, 29 Mar 1985, *McLaughlin 2986* (ARIZ 257592, det. Barry A. Prigge 1989).

TA: Tinajas Altas Mts, W end of Pass just N of Tinajas Altas Pass, 1080 ft, in wash, *Van Devender 6 Mar 1983* (ARIZ 240826, det. C.M. Christy 1995). Butler Mts, 780 ft, sand dune, *Van Devender 27 Mar 1983* (ARIZ 240825, det. C.M. Christy 1995).

Mentzelia involucrata S. Watson
[*M. involucrata* var. *megalantha* I.M. Johnston]
Silver blazing star; *pegapega*. Figure 28.

Winter-spring ephemerals. Stems relatively stout, branching from the base, shiny white, hairy (scabrous-hispid), not peeling. Leaves sessile, narrowly lanceolate to elliptic, coarsely toothed to

pinnatifid, the lower ones (3) 5–18 cm long. Bracts 1.5–3 cm long, with a broad whitish membranous center, green margins, and several slender pectinate lobes. Flowers pedicelled. Calyx lobes 8–16 mm long. This is the largest-flowered mentzelia in the region, with petals 2–3.7 cm long, satiny silvery white to pale yellow with orange veins. Outer filaments expanded toward the tip into 3 teeth, the anther on the middle tooth. Capsules 1.5–2.2 cm long. Seeds often 3–3.5 mm long, thick but flattened, ovoid, not winged, whitish and usually constricted in the middle (equatorially). Drought-stressed plants can be quite small with proportionally smaller parts.

Widely scattered across Organ Pipe and most of Cabeza Prieta.

Western and central Arizona, northwestern Sonora, southeastern California, and Baja California.

Figure 28. *Mentzelia involucrata*. N foothills of Puerto Blanco Mts, North Puerto Blanco Drive: (A) 5 Mar 2005; (E) 10 Mar 2008. (B) Ajo Scenic Loop Drive, S of Ajo, 26 Mar 2014. (C) Lookout Mountain, N of Ajo, 2 Mar 2014. (D) Near campground at Red Cone, Pinacate Biosphere Reserve, Sonora, 29 Feb 2008.

OP: Quitobaquito, *Clark_25 Mar 1944* (ORPI). Growler Mts, foothills, 16 Apr 1952, *Parker 7970*. 13.4 mi by road NW of Visitor Center, Puerto Blanco Drive, 10 May 1979, *Bowers 1715*.

CP: Sheep Tanks, 28 Mar 1935, *Kearney & Peebles 11012*. 7 mi by road E of Papago Well, 18 Feb 1979, *Bowers 1573*. 3.8 mi N of Tule Well, Cabeza Prieta Mts, 9 Mar 1986, *Van Devender 86-17*. Pinacate Lava, 21 Mar 1992, *Harlan 66* (CAB).

Mentzelia isolata Gentry
Figure 29.

Summer ephemerals with slender stems. Leaves petiolate; blades 2–14 cm long, sometimes exceptionally large following ample rain, ovate to lanceolate, often with 1 or 2 pairs of basal lobes, the lower (basal) leaves often with elliptic blades. Flowers and fruits sessile. Sepals usually persistent. Petals 5–7 mm long, orange. Staminodes none, although outer stems with slightly broadened filaments. Capsules 2–3 cm long, slender, tapering to the base. Seeds angled, not winged, appearing in one row.

Known from higher elevation in the Ajo and Diablo mountains and Dripping Springs in the Puerto Blanco Mountains.
Eastward in Arizona to Cochise County and southward to Sinaloa.

OP: Above Dripping Springs, *Supernaugh 27 Oct 1951* (ORPI). Bull Pasture, *Wirt 13 Aug 1990*. Diablo Mts, 807 m, shaded base of N-facing cliff, 22 Sep 2013, *Rutman 20130922-22*.

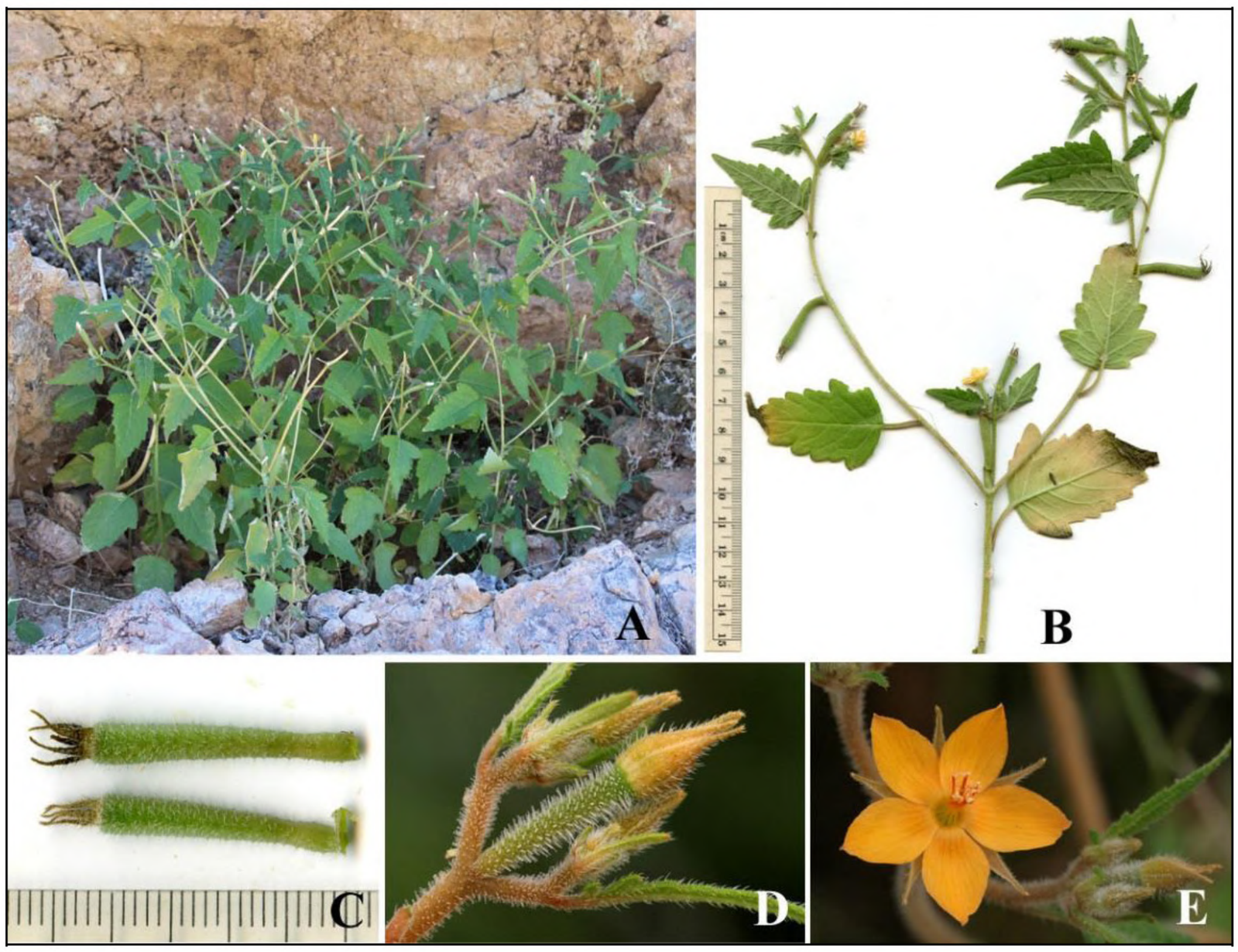

Figure 29. *Mentzelia isolata*. (A) Bull Pasture, 25 Sep 2013. (B & C) Trail to Bull Pasture, 8 Sep 2014. (D & E) Portal-Paradise Road, Chiricahua Mts, Cochise Co., 2 Jul 2006, photos by Patrick Alexander (SEINet).

Mentzelia longiloba J. Darlington var. **longiloba**
[*M. multiflora* (Nuttall) A. Gray subsp. *longiloba* (J. Darlington) Felger]
Blazing star; *pegapega*. Figure 30.

Robust winter-spring ephemerals or perhaps sometimes short-lived perennials (often perennial elsewhere); stems few to many, often 40–75 cm tall, white with barbed short hairs. Leaves

sessile, narrowly lanceolate to oblanceolate and pinnately lobed to parted, first ones in basal rosettes, (5.5) 9–15 cm long, the stems leaves reduced above. Flowers pedicelled, in terminal corymbs, several per cluster. Bracts linear to linear-triangular, 8–12 mm long. Calyx lobes 8–13 mm long. Petals bright yellow, often with orange stripes, seemingly 10 (the 5 inner ones staminodes with anthers at apex), larger petals 12–26 cm long. Stamens bright yellow, numerous; inner filaments slender, the outer filaments broadly winged and grading into the petals. Capsules 1–2 × 0.8–1 cm. Seeds numerous, 3.3–4 mm long, the body flat, light brown, surrounded by whitish wings that become transparent when wet.

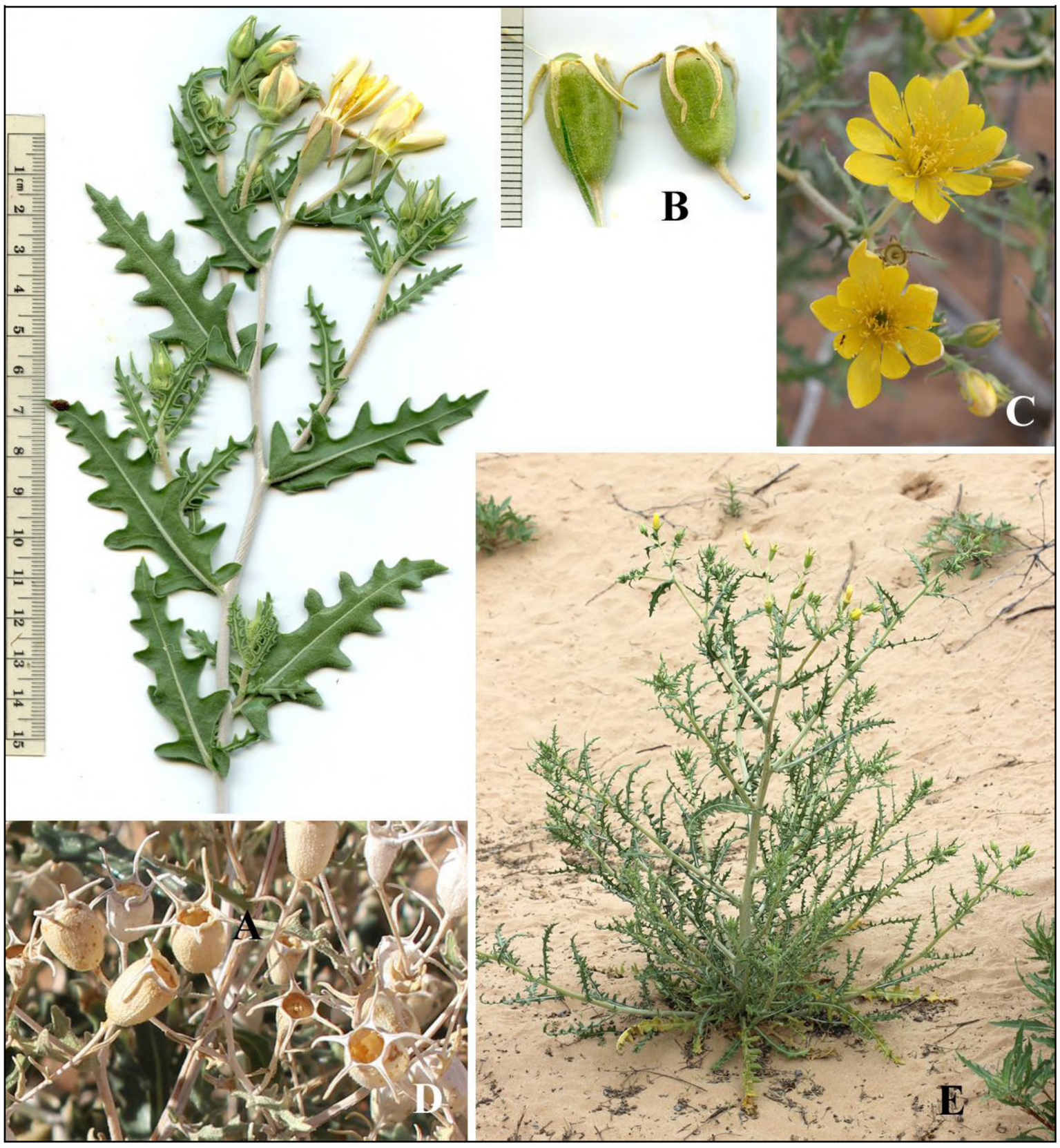

Figure 30. *Mentzelia longiloba* var. *longiloba*. (A & B) Ajo Way at La Cholla, Tucson, 28 Sep 2014. (C) Dunes S of Sierra Blanca, Pinacate Biosphere Reserve, Sonora, 20 Feb 2005. (D) Pinta Sands, 11 Feb 2014. (E) Dunes near Mayan Palace, about 25 miles SE of Puerto Peñasco, Sonora, 20 Feb 2015.

Sand flats and dunes in Cabeza Prieta, especially the Pinta Sands, scattered in Organ Pipe, mostly in gravelly-sandy washes and canyon bottoms, and canyon washes in the Tinajas Altas Mountains.

This species, with three varieties, ranges from southern California to Utah and west Texas, and northern Mexico from Baja California to Coahuila. Var. *longiloba* is the most widespread of the

three, occurring from southeastern California to Utah and west Texas and adjacent northern Mexico (Schenk & Hufford 2010). *Mentzelia longiloba* var. *pinacatensis* J.J. Schenk & L. Hufford occurs in Sonora just south of the flora area and might be found in adjacent borderlands of the flora area, especially the Tinajas Altas Region.

The seeds of this species and at least some others were parched and ground and the flour consumed as gruel. The seeds are available mostly mid- to late spring. There is no direct evidence of use in the flora area, but the seeds were widely used elsewhere, including southern California (Bean & Saubel 1972) and have been recovered from archaeological caches (Hodgson 2001).

OP: Rancho Bonito, La Abra Valley, 9 Dec 1939, *Harbison 26217*. Alamo Canyon, *Tinkham 15 Apr 1942*.

CP: Pinta Sands: 21 Mar 1979, *Yatskievych 79-242*; 11 Jan 2002, *Felger 02-26* (det. John J. Schenk, Dec 2009). W edge of Pinacate lava flow, 800 ft, sandy flats, *Larrea*, *Hilaria*, 29 Mar 1985, *McLaughlin 2985* (det. John J. Schenk, Dec 2009). 0.5 mi S of Sunday Pass, *Cain 15 Nov 2003* (det. John J. Schenk, Dec 2009).

TA: Frontera Canyon, 18 Mar 1998, *Felger* (observation, variety uncertain).

Mentzelia puberula J. Darlington
Argus blazing star. Figure 31.

Short-lived perennials often 30–60 cm tall, with stems branching throughout, sometimes like dwarf shrubs with woody lower stems. Stems whitish and leafy; leaves (1.8) 2.5–6.5 cm long, mostly dull gray-green, more or less ovate-lanceolate to elliptic or obovate, coarsely toothed to shallowly lobed, the uppermost leaves sessile, the lower ones gradually narrowed basally. Bracts linear. Flowering spring and summer depending on rains, the flowers opening in the late afternoon. Petals and stamens bright yellow on interior surfaces, pale on backs, the petals 5 in number, 10–13 mm long, rounded at tip. Inner filaments slender, the outer filaments broadened (petaloid) and grading into the petals but clearly narrower than the 5 petals. Capsules 5–9 mm long, rounded at the base. Seeds many, horizontal in the capsules, 2.4–3.1 mm long, conspicuously winged, papery and white when dry, the wings transparent when wet and the body

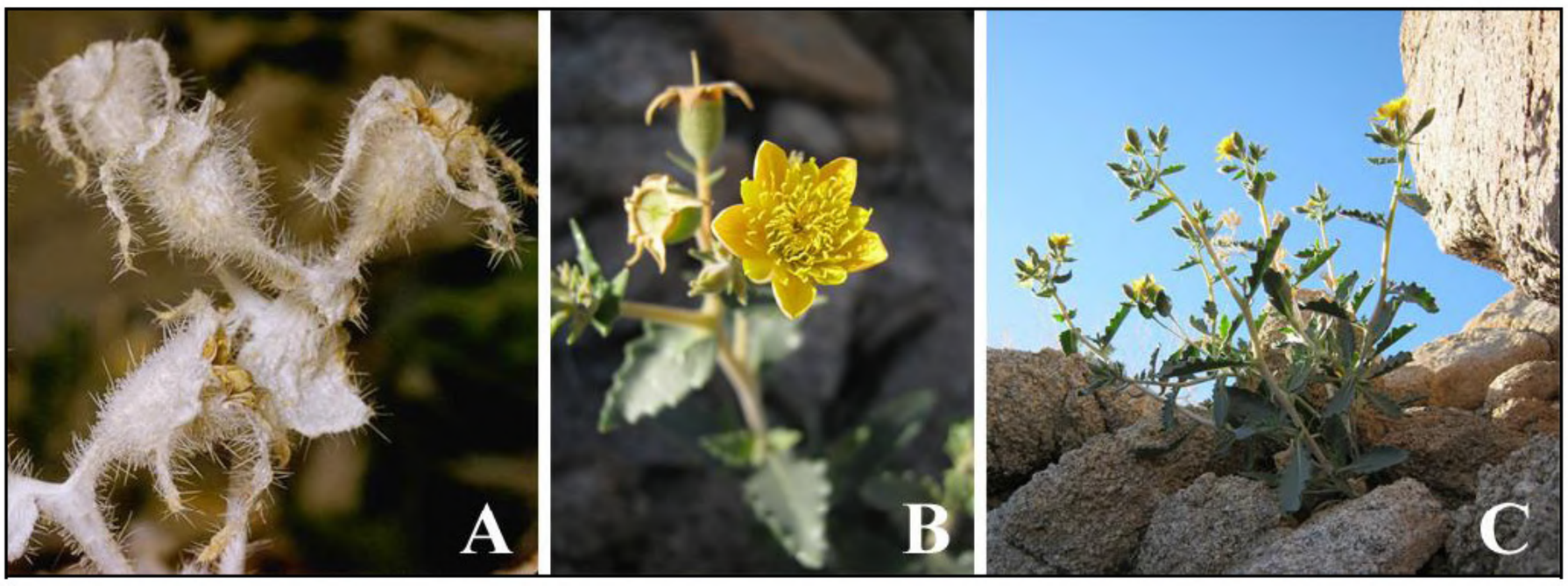

Figure 31. *Mentzelia puberula*. Chocolate Mts, Imperial Co., CA, 7 Mar 2011, photos © by Duncan Bell (CalPhotos).

Found in widely scattered localities in the flora area, especially at higher elevations in arid mountains. It was in the Butler Mountains 3800 years ago and is still there.

Deserts in western Arizona, California, Nevada, Baja California, and northwestern Sonora.

CP: Childs Mt, summit near radio towers, 2845 ft, 18 Aug 1992, *Felger 93-298*. Sierra Pinta, summit, *Cain 15 Nov 2003*.

TA: Tinajas Altas, cliff face, 10 Mar 1980, *Reichenbacher 480*. Butler Mts, *Van Devender 27 Mar 1983*. †Butler Mts, twigs, seeds, 3820 ybp.

Petalonyx – Sandpaper plant

Shrubs or perennial subshrubs, and some may flower in the first year or season; conspicuously scabrous (sandpaper-like) and hispid with short and long hairs. Leaves sessile. Inflorescences racemose or spicate; each flower subtended by an involucre of 3 bracts, the outermost largest and innermost smallest, the bracts enveloping the buds. Petals 5 and white. Stamens 5. The genus is unusual in that the stamens appear to be outside the petals: near the base of the petals the stamens pass through a slit between the petals. Fruits of small achenes, indehiscent and 1-seeded.

Southwestern USA and northwestern Mexico; 5 species.

1. Leaves entire, mostly linear or oblong; petals separate ..... **Petalonyx linearis**
1. Leaves toothed, or if entire then triangular; upper part of claws of petals forming a tube ..... **Petalonyx thurberi**

Petalonyx linearis Greene

Narrow-leaf sandpaper plant. Figure 32.

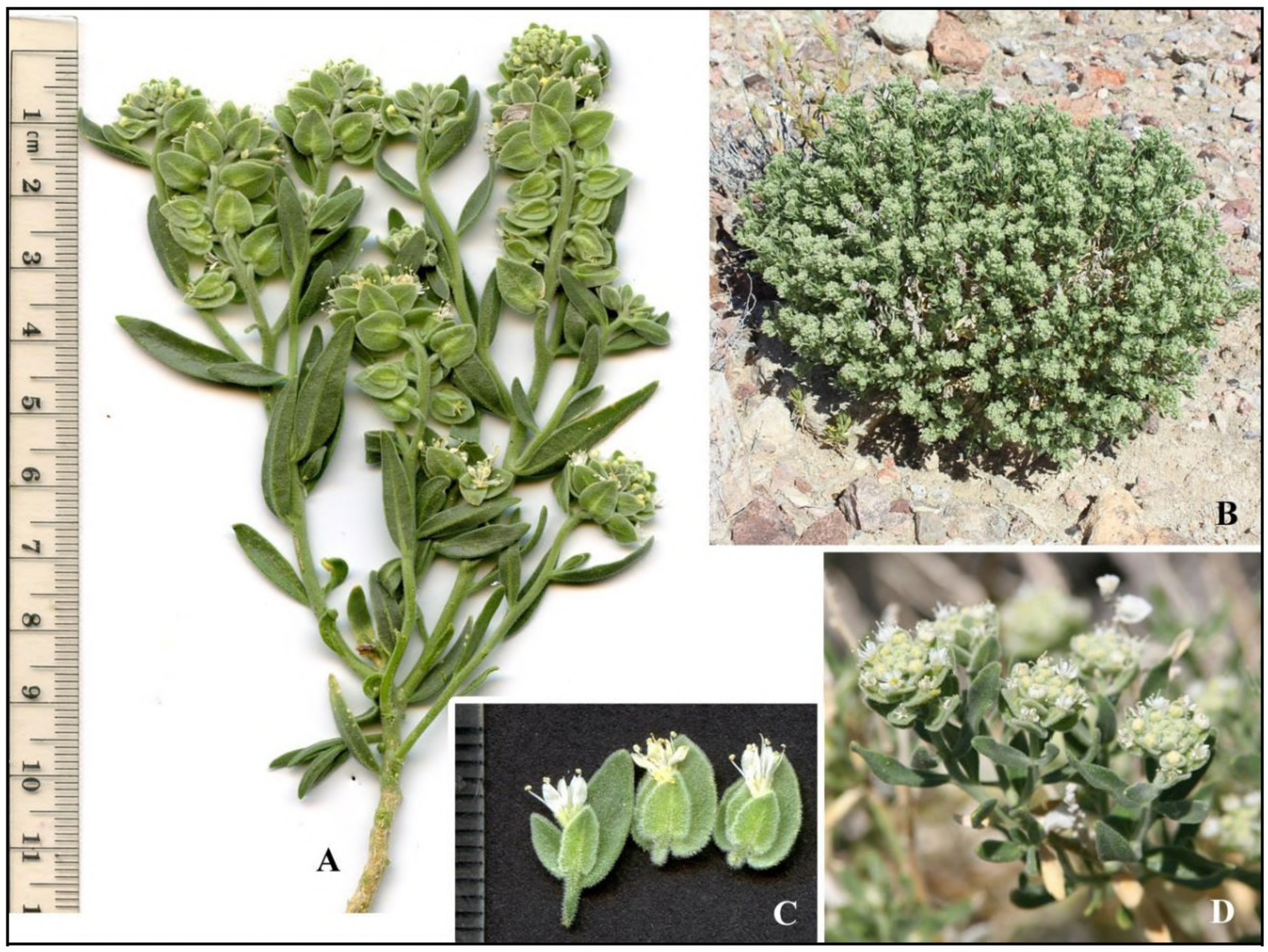

Figure 32. *Petalonyx linearis*. (A–C) Acuña Valley, 15 Mar 2015. (D) On cinders and lava near Red Cone campground, Pinacate Biosphere Reserve, Sonora, 7 Mar 2009.

Perennials forming rounded bushes 30–50 cm tall, with many erect-ascending brittle and leafy stems, and often flowering during the first season. Leaves gradually drought deciduous, 1.2–3.5 cm long, linear-oblong to linear-lanceolate or linear-oblanceolate, more than twice as long as wide; margins entire. Inflorescences terminal, of densely flowered racemes. Outer floral bract ovate, cordate at the base, the margins entire or sometimes with a few small teeth. Petals, filaments, style,

and stigma translucent white; anthers cream colored. Calyx lobes 1.5 mm long. Petals 3–5 mm long, separate, and narrowed to a slender claw. Stamens about as long as to half again as long as the petals. Achenes ovoid, 2–3 mm long, brown, tightly enclosed in the dried floral tube. Flowering at least in spring and fall.

A calciphile, localized on widely scattered arid, rocky slopes in Organ Pipe and the Tinajas Altas Mountains. It has been in the Tinajas Altas Mountains for more than 9200 years.

Western Arizona, southeastern California to northern Baja California Sur and northwestern Sonora.

OP: Puerto Blanco Drive, 1700 ft, 12 Apr 1978, *Bowers 1259*. 2.5 km NW of Dripping Springs, rocky hills, 9 Mar 1988, *Baker 7589* (ASU).

TA: Tinajas Altas, 1 Dec 1938, *Goodding 5335*. Tinajas Altas, 2000 ft, cliff face, SW-facing slope, 10 Mar 1980, *Reichenbacher 479*. †Tinajas Altas, leaves, 1230 & 9230 ybp.

Petalonyx thurberi A. Gray subsp. **thurberi**
Sandpaper plant; hadsadkam. Figure 33.

Bushy perennials to woody-based shrubs (0.5) 1–1.8 m tall with several to many stems. Larger, lower leaves of new shoots 2–5 cm long, elliptic to lanceolate, coarsely toothed, and soon deciduous; leaves gradually reduced upwards, leaves of upper stems often 0.6–2 cm long, broadly lanceolate to ovate, few-toothed to entire, the uppermost ones triangular. Inflorescences of densely-flowered short racemes. Outer floral bract more or less ovate, coarsely few-toothed. Petals, filaments, style, and stigma white; anthers cream colored. Calyx lobes 2 mm long. Petals 3–6.5 mm long, the claws free basally and connivent (coming together but not organically united) above to form a slender tube. Stamens long exserted. Achenes 1.5–3 mm long. Flowering at least late spring and fall. Stems sometimes bending with weight of flowers, the flowers attracting swarms of hover flies (syrphid flies).

Scattered localities across the lowlands of Cabeza Prieta and Organ Pipe; often in places without other vegetation such as scoured gravelly beds of larger washes.

Western, central, and southern Arizona, southern Nevada, southeastern California to northern Baja California Sur and northwestern Sonora. Another subspecies occurs in California and Nevada.

OP: Bates Well, *Nichol 26 Apr 1939*. Hooker [Hocker] Well, *Simmons 13 Oct 1963*. Camino de Dos Republicas, 2 mi E of Hwy 85, 10 May 1979, *Bowers 1723*. Aguajita Wash, 6 Apr 1988, *Felger_86-288*. Cuerda de Leña (wash), 0.5 mi S of ORPI north boundary, 7 Oct 2006, *Rutman 20061007-18*.

CP: Cameron (Adobe) Wash, *Simmons 19 May 1963* (CAB). Daniels Arroyo at Charlie Bell Rd, 12 Jun 1992, *Felger 92-548*. Growler Wash at E boundary, 12 Jun 1992, *Felger* (observation). Daniel's Arroyo, arroyo gravels, jackrabbit browsed, 31 Mar 1997, *Harlan 486*.

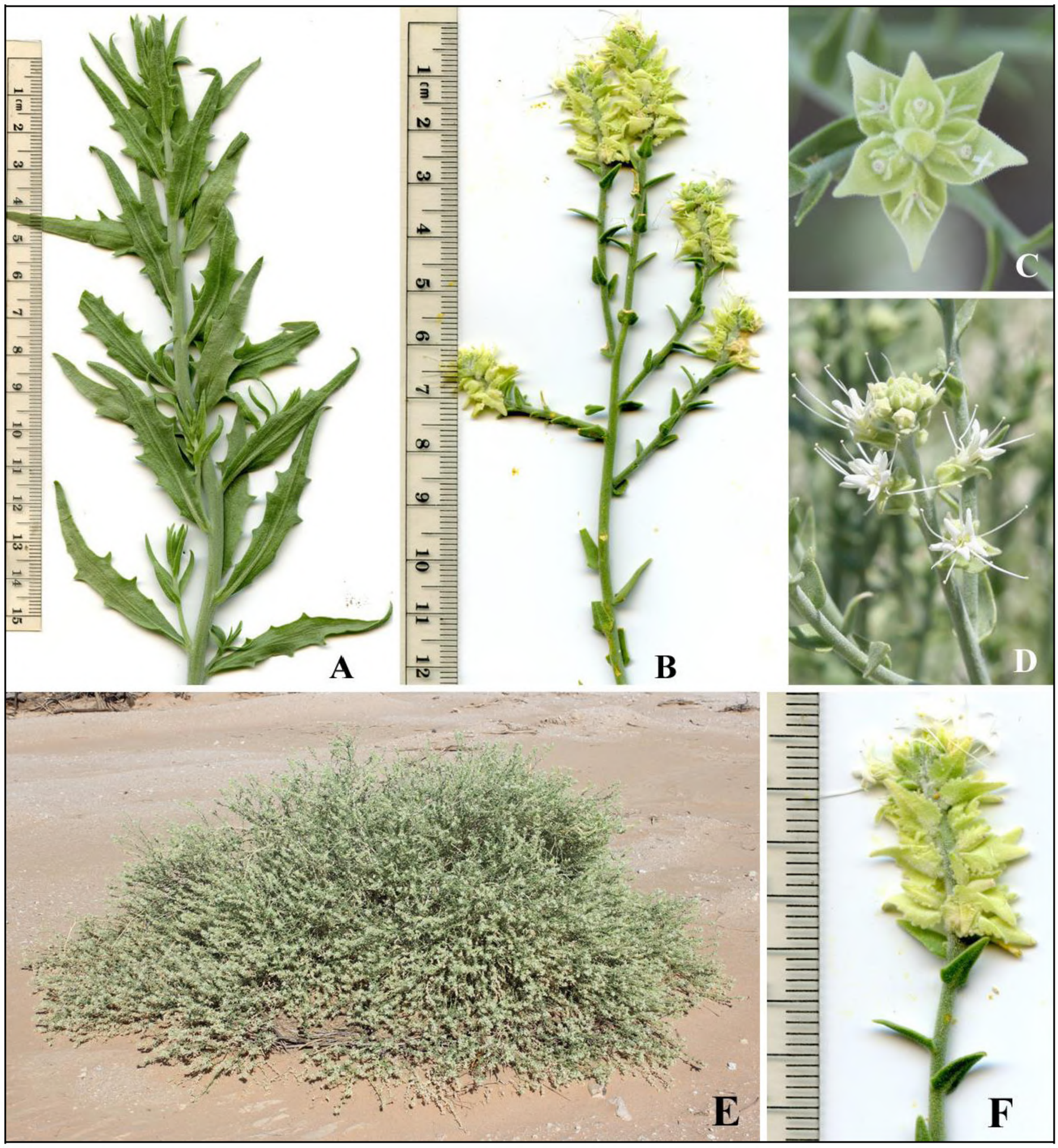

Figure 33. *Petalonyx thurberi* subsp. *thurberi*. (A, C, & F) Ten Mile Wash N of Ajo, 23 May 2010. (B & E) Wash near dunes about 25 miles SW of Sonoyta on Mex Hwy 8, 9 Sep 2014. (D) Growler Wash, N of Bates Well Road, 7 May 2006.

LYTHRACEAE – LOOSESTRIFE FAMILY (includes Punicaceae)

Herbs to trees. Worldwide; 31 genera, 620 species.

****Punica*** – Pomegranate

Native to the Middle East and India: 2 species.

****Punica granatum*** Linnaeus

Pomegranate; *granada*; galna:yu. Figure 34.

Shrubs to about 3 m tall; planted long ago along irrigation ditches below the pond and perhaps elsewhere at Quitobaquito. Flowers bright red-orange, in March and April and sporadically

through summer; fruits ripe in late summer and early fall. Ripe fruit rinds pale yellowish with a pinkish blush near apex, the fleshy pulp translucent white, refreshing and moderately sweet. Betty Melvin (in Zepeda 1985: 56) recalled, "There were some pomegranates near the water and, yes, we ate pomegranate." Other cutting-grown pomegranates from Quitobaquito, such as ones conserved at the Desert Botanical Garden in Phoenix, have reddish rinds and pale pinkish seeds and pulp.

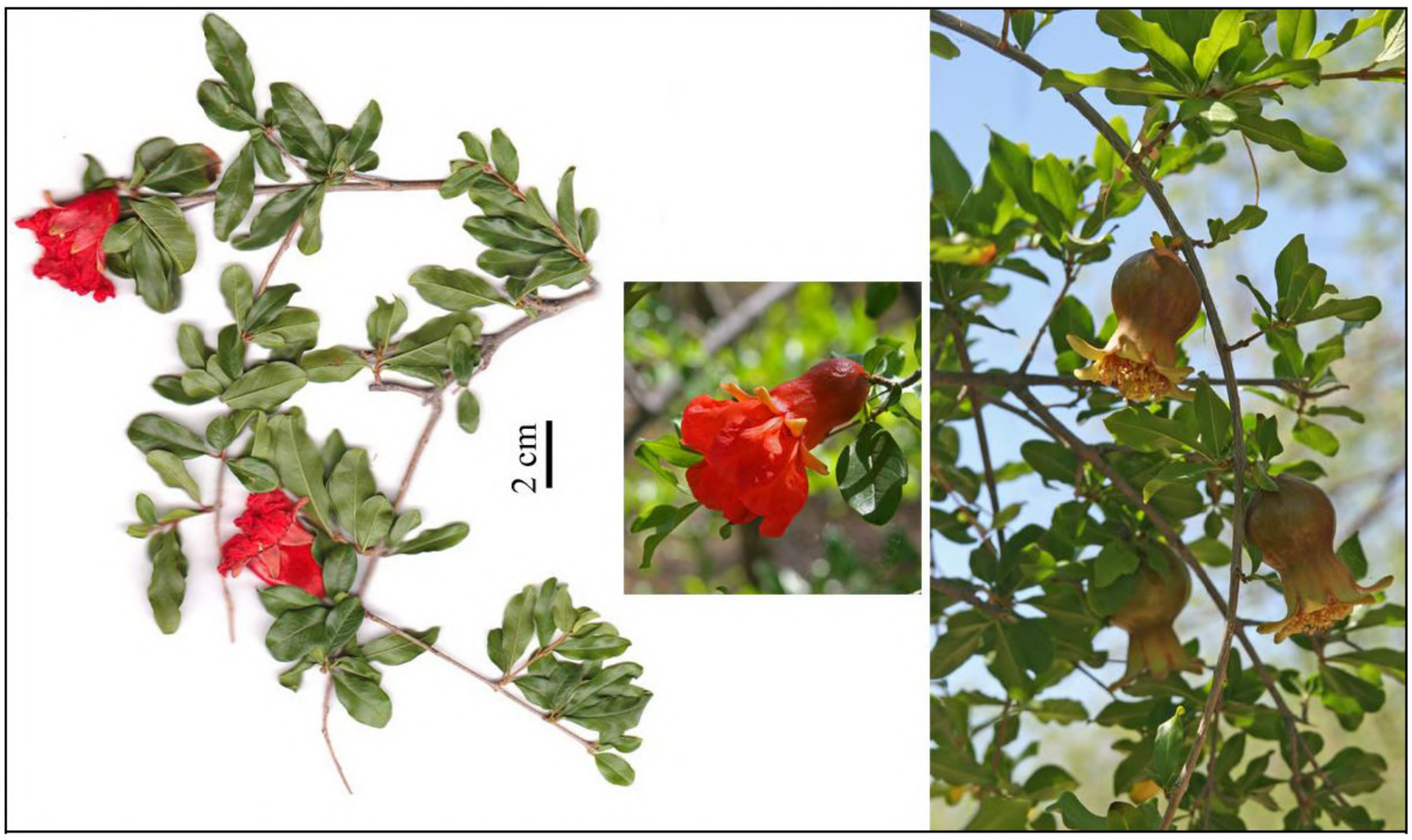

Figure 34. *Punica granatum*. Quitobaquito, 2 May 2008.

Perhaps there were multiple plantings, including those by Arnold N. Dorsey in the 1860s (Hoy 1970: 48; Sue Rutman's extensive genealogy research reveals that Hoy incorrectly called him Andrew Dorsey), and later plantings by O'odham residents (Felger et al. 1992; Zepeda 1985). Pomegranate cultivars are propagated by cuttings and the ones at Quitobaquito found in the late 20th century were apparently one or more clones.

Many of the perhaps few dozen pomegranates had perished by the 1980s. In late 1989 the Park Service began irrigating the plants, and by summer 1990 the surviving plants had recovered remarkably. But subsequent encroachment by *Atamisquea*, *Prosopis velutina*, and *Ziziphus*, along with low rainfall, and the near loss of water in the pond (lowered water table) took a toll on the precarious remnants of the orchard. By 2010 only four pomegranates persisted and were barely surviving in 2011. At that time the Park Service made cuttings and began propagating them in their nursery at the headquarters.

OP: Quitobaquito: *Van Devender 31 Aug 1978* (ORPI); 6 Apr 1988, *Felger 88-309*; Small grove below pond, shrubs to about 3 m tall, 19 Jun 1989, *Felger 89-244*. Desert Botanical Garden, cultivated, from Quitobaquito, *Brown 30 Mar 2005* (DES).

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